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Freedom of the Universities

WITH what now seems almost prophetic insight, the report of the University Grants Committee in 1936 referred to the special responsibility of the universities of Great Britain, in view of the suppression in the universities of several European and other countries of all independent thought and critical discussion of the principles of government or of the meaning of life, if the Greek tradition of candid and intrepid thinking about the fundamental issues of life is to be preserved for mankind. That responsibility has grown the heavier in the last three years. The area in which freedom of thought and learning is proscribed has grown larger year by year, and further waves of refugees have added to the burden of the Society for the Protection of Science and Learning, and converted what was possibly at first regarded as a temporary into an apparently permanent or perennial task.

There are welcome signs that their responsibility is nobly recognized by the universities of Great Britain. In one practical form it is seen in the support which has been forthcoming from them for the work of the Society for the Protection of Science and Learning. A series of meetings has been arranged for the first week in February in the majority of British academic centres, in which many leading men of science have promised to take part, including Sir William Bragg, Sir Henry Dale, Sir Richard Gregory, Prof. Winifred Cullis, Prof. F. A. E. Crew and others. The Royal Society, in collaboration with the British Academy, is giving a special reception to the academic exiles and those who have been working in their interests on February 7, and on February 10 the evening discourse at the Royal Institution is to be given by Prof. Max Born, one of the many distinguished men of science who have found refuge in Great Britain.

This practical assistance is of importance not only on the grounds of humanity but also in the interests of learning itself, by enabling those who in the past have made important contributions to knowledge to resume their studies or investigations. Besides this, however, there is a rapidly growing volume of evidence that members of the universities of Great Britain, whether engaged in teaching or administration, are fully alive to the importance of preserving their full freedom of teaching and investigation. In a striking address to the Conference of Education Associations on "The Function of the University", Lord Macmillan asserted that the first essential of a university must be its spirit of intellectual freedom. A university must be the servant of truth, and have no other bondage whether of race, State or creed.

Lord Macmillan put freedom in the very forefront of the life of the university, as it is known in Great Britain. It is the essence of knowledge that it should give freedom to those who pursue it. To seek to impede the free interchange of thought and ideals is the supreme crime. The noblest task which the universities can perform is not only to maintain among ourselves the constant and free pursuit of truth, but also to use every endeavour to spread its light throughout the world, so that it penetrates even to those countries where the universities are subservient to the State.

No less striking were the speeches at the recent degree ceremony when the Duke of Devonshire was installed as Chancellor of the University of Leeds. In welcoming the Chancellor, Mr. B. Mouat Jones referred to him as one who, by tradition and conviction, accepted both the universality of

knowledge and the trust imposed upon universities to safeguard the liberty of thought and to defend the free spirit of man. In returning thanks for his election, the Chancellor responded on the same note. Of all the forces working for good in the world, for better understanding between peoples, for liberalism and tolerance in the highest sense of the words, for the spreading of true knowledge, the universities and all that they stand for are, he said, perhaps the most important. They are playing a greater part than ever in the life of the nation and their influence is felt among an increasing proportion of the population. Moreover, without minimizing the importance of the practical and utilitarian work at the universities, or their contribution to technical and commercial progress, a university must be a servant of truth.

In delivering an address at the close of the ceremony, on behalf of the honorary graduates, Lord Baldwin spoke vigorously on the same theme. There are two things, he said, for which a university stands pre-eminently: standards, and truth. The more democratic we become, the more important it is to maintain our standards in literature, in art, in science, in work of all kind. Nothing should for one moment be accepted as first-rate which is in fact second-rate. The second thing is truth, which is particularly important to-day. It is not yet in danger in Great Britain and he hoped it never would be. We never want to see the day when truth is sought merely with the object of proving a case, or history written with that object. Universities must stand and be recognized as seekers for truth with no ulterior motive.

It is a strange commentary on the distance we have travelled in the last ten years that the chancellor of a university should find it pertinent to speak thus emphatically on what a few years ago would have seemed a platitudinous theme, and to find his words so warmly welcomed. Lord Baldwin, moreover, proceeded to point out dangers which in Great Britain might affect, even if indirectly, the maintenance of such standards and the service of truth.

For universities to uphold their trust to-day, as ever, they must be absolutely free and independent, governing themselves and regulating themselves, and never becoming subservient. Among the dangers which may threaten their independence Lord Baldwin referred first to that attending the influence of wealth. In Great Britain it is scarcely a source of danger, for when people give money to universities, it is not given with the idea of interference, but for use. It is for the universities themselves to decide in what way the gifts shall be expended. While this is generally true, in his recent book "The Social Function of Science" Prof. J. D. Bernal refers to ways in which the freedom of a university may be restrained by conditions attached to grants, and indicates that cases of the withdrawal of donations on political grounds are known to many scientific workers. If universities are to make their full contribution to the life of the community, while their members must be careful not to lend the weight of their names or influence to the support of statements on matters of which they have no special knowledge, it would be disastrous if any such restraint prevented individual members of a university from accepting their responsibilities for playing a part in the life of the community, whether as citizens or as the leaders for which their training and ability fit them. An atmosphere of right thinking and right action is demanded as well as freedom, and this is the more important as the emphasis on the social quality of the university is increased.

The greatest danger, however, which threatens the independence of the universities is one from which Great Britain is fortunately so far free—that of State interference. This we have seen in Europe in our own time, though had we not seen it we could scarcely have believed it. Universities depend more and more on State grants and public money, and this dependence is likely to increase rather than to decrease. The burden of equipment and re-equipment for efficient research is one factor likely to increase the need for State assistance. The more democratic that entry to our universities becomes, and the more widely their importance in training leaders is recognized, the stronger their claims upon the State for assistance. Many of the admirable recommendations, for example, of the recent Conference of the National Union of Students on student health depend largely on State assistance if effect is to be given to them. In spite of this, as Lord Baldwin asserted, the universities must resist to the death, if it ever came, any attempt of a Government department, or of a Government of any shade of opinion, to make gifts conditional on what is taught. In view of what has happened in other countries in recent years, we must be doubly vigilant in safeguarding our own liberties and our own freedom. It is a false optimism to eschew such vigilance because there is no immediate threat, especially in the face

of what is happening elsewhere in the world to-day. Circumstances can easily be visualized in which the threat might become imminent even in Great Britain. Nor is the threat confined to the totalitarian regimes. Even in the western hemisphere, religious dogma has already sought to restrain the teaching of particular scientific theories in the post-War period.

In Great Britain, as has already been pointed out, one or two attempts have been made, if not from the Government side, to impose restraints by withholding donations or subscriptions. When university needs are growing and financial stringency threatens, it is the more important that universities should stand together in resisting such pressure and in exposing the instigators. Such danger as exists is in fact largely indirect. It arises in part from the unfortunate extent to which teaching and research are linked under our present system. Conditions which may quite legitimately be laid down in regard to the donation of a large sum for research are quite intolerable if applied to teaching. None the less, because teaching and research are so interlocked, quite unintentionally endowment of research in this way may affect the prestige or extent of freedom of teaching in a particular subject.

Particularly is this true in the social sciences. On the universities above all lies the responsibility for developing a world conscience and a world culture if mankind is to be turned aside from the hideous road to economic self-sufficiency and war. Moral unity can only be achieved through mutual understanding, respect and approbation, and we need more than ever to bring into relief the true aim and purpose of human society. Social science in this sense can bring into being a vital relation between the university and the non-academic world, but it can only do so as long as it possesses, unchecked and unhampered, its full liberty of criticism and investigation, free from any suggestion of prejudice or bias.

Many will recall Lord Baldwin's insistence on this same responsibility for preserving freedom and all it involves in the elimination of prejudice and of bias by the maintenance of scrupulous honesty of thought and fairness of criticism, in his welcome to the delegates to the Congress of the Universities of the Empire held at Cambridge three years ago. Scientific workers may be equally grateful for his latest reminder of their obligations and duties in this matter. Contact with many of the refugee scientific workers whom the Society for the Protection of Science and Learning has been assisting should render their own experience available for the vital task of foreseeing the threats to our great heritage of freedom and integrity of thought, and taken in due time, wise measures may be devised to minimize the danger, if not to avert it entirely. Certain it is that freedom is best served to-day by vigilance and foresight and constructive action, rather than by procrastination which may leave us merely with the option of resisting unto death.

French Administration in Africa

African Majesty:
a Record of Refuge at the Court of the King of Bangangté in the French Cameroons. By F. Clement C. Egerton. Pp. xx + 348 + 123 plates. (London: George Routledge and Sons, Ltd., 1938.) 18s. net.

MR. EGERTON'S choice of a change of scene to escape certain features of civilized life was little more than fortuitous; but in the event it proved well judged for his purpose. For some months he lived in the headquarters of a native king of the French Mandated Territory of the Cameroons, and came into intimate contact with a cultural outlook and organization of life which he found novel, but in its cultural environment, essentially reasonable, allowance being made for certain adjustments necessitated by the regulations of the mandatory power.

The author has had the advantage of training under Prof. Malinowski. It is, therefore, scarcely necessary to say that life as he viewed it at the *chefferie* of Bangangté was seen as a whole. The history of this kingship, unlike others enshrined in shorter memories in this part of Africa, is known for some ten generations. The country has been in the possession of the people, immigrants, for not more than a hundred years. In consequence, it is possible to trace to a well-defined origin certain peculiar characters in the social organization, such as, for example, the institution of the chief's henchmen, and the delegation of the chiefly authority to local sub-chieftains. The whole essence of the kingship seems to have resided in

organization for war; but under European control the office would appear to be stripped of its meaning. Yet the present king, probably a forceful personality under a deceptive exterior, in some manner which Mr. Egerton was not able to fathom, has retained his sacrosanctity, even for radically-minded individuals, who did not refrain from criticism, and even regarded any member of the blood-royal as something of a rogue.

Informative as is the author's account of a society largely pagan, his remarks on their character and on French methods of administration, both in relation to future development, are even more illuminating. They are those of a well-balanced and careful observer. His attitude towards the French administration, so far as it goes, is wholly favourable; and while he regrets change in the native, he accepts the fact as inevitable. He maintains, however, that the changes which European control has introduced, in what is intended to be the spirit of the mandate, are advantageous to the white man rather than to the native. This perhaps is to take a short view. Custom at present, he notes, is preserved under the influence of the members of the community who are more than thirty years of age; but desire for the power, which obviously is inherent in the white man, attracts the native and leads to imitation, which appears to fasten on the less desirable features in white character and culture. The needs of the people of the Cameroons, as the author sees them—he attempts no judgment on Africa as a whole—is for the reinforcement of custom under a strong personal administration, which will ensure, through the co-operation of the chiefs, its compulsory observance. Further, the future of the African, he holds, demands a policy which should not be at the mercy of an uninstructed democracy, or made subservient to European political relations.

Mr. Egerton writes lightly and easily; but no reader of his book should allow himself to be misled into thinking that what he has to say is not deserving of most careful and mature consideration.

The Practice of Plant Propagation

Propagation of Plants:
a Complete Guide for Professional and Amateur Growers of Plants by Seeds, Layers, Grafting and Budding; with Chapters on Nursery and Greenhouse Management. By Prof. M. G. Kains and L. M. McQuesten. Pp. x + 555. (New York: Orange Judd Publishing Co. Inc., 1938.) 3.50 dollars.

IN the forefront of programmes of agricultural and horticultural research of the last twenty years have been placed agronomic studies of economic plants; thus extending applied botanical investigations into the yield, in quantity and quality, of these plants. The technique employed in the maintenance and multiplication of such plants has of necessity also been subject to closer scrutiny, although but infrequently forming the major item of the programme at any one station or institution. It is not surprising that a standard text-book written twenty years ago required thorough revision in the light of such newly acquired knowledge. The present authors claim in their preface to have carried out such a revision, and a brief survey of the contents of the volume under review generally substantiates their claim.

The earlier chapters deal with topics related to the establishment in field and garden of many short-lived plants; these include germination studies and methods of seed testing. The Seeds Act of 1920 and the regulations laid down in 1922 govern the tests made in Great Britain of agricultural seeds and vegetables; whilst seed establishments of high repute test their flower seeds also. Whilst there are differences between the American and British legislation concerned, the technique of seed testing in the two countries is in many respects similar, so that the subject-matter of these chapters is of value to seed analysts and other British readers. Fortunately all the "fifty worst weeds" of the United States (listed as table 15) have not become established in Great Britain.

Recent studies made at the Boyce Thompson Research Institute by Dr. Crocker and his staff have demonstrated the importance of storage conditions in relation to subsequent germination; the value of stratification, ensuing adequate moisture and fluctuating cool temperatures, has been scientifically established. In Great Britain it has been proved with rosaceous seeds that such methods compare very favourably with others, including prolonged colder storage. The table showing the effective temperatures and periods of stratification with many seeds is a valuable feature of the work. In discussing the influence of light upon seed germination, the authors have presented rather a brief list of light-sensitive seed, omitting reference to *Lythrum* and *Primula* species known to be highly sensitive. The germination of orchid seeds receives scant treatment; mycorrhizal fungi

are not mentioned. Mention is made of the fungi causing the 'damping off' of seedlings, and formalin is recommended as a control measure. The widespread use in Great Britain of Cheshunt mixture (prepared from copper sulphate and ammonium carbonate) is evidently not an American practice, but it is one that can be most strongly recommended to American nurserymen and amateur gardeners. The proved value of additional phosphates mixed in the compost after soil sterilization has been clearly demonstrated by Lawrence at the John Innes Institution; other practical points concerning the injurious effect arising from the mixing of chalk or lime with humic matter before sterilization have also been established, but no reference to this work was found in this text.

All manner of vegetative methods of propagation are serially brought under review, and there can be little doubt that the many illustrations in this section will assist students, and more especially those who cannot regularly carry out the operations so clearly described. From the Dutch growers and their research stations information regarding hyacinth propagation has been freely drawn upon; the methods of the late Dr. Griffiths and his associates used in the propagation of lilies from bulbils and scales are briefly described. More recent research comes under review in the chapters dealing with the propagation by stem cuttings. The use of several synthetic growth substances in accelerating and facilitating root development is dealt with, and in this section the authors have reviewed the work of Dr. Zimmerman and his associates in the United States, and that of investigators in Great Britain.

In the section dealing with the control of pests, a useful practical point concerning eelworm infection of herbaceous phlox might be added to a later edition; from root cuttings non-infected plants are readily raised, as is a Wisley practice, whilst stem cuttings remain infected.

When reading of the propagation of fruit trees, and methods of grafting and the after treatment of grafted trees, and particularly (Chapter xiv) when considering fruit tree stocks and the influence of stock on scion and the reverse processes, the value of the book would have been enhanced for British readers had the authors considered in further detail East Malling work upon the classification of apple stocks and the influence the various types exert; reference is, however, made to certain effects of root-stocks on the blossoming of seedling apples. The authors deal with citrus stocks, and other trees not grown to any large extent in Great Britain.

The modern tendency towards mechanization is seen in the illustrations and descriptions of machinery used in nursery management. The American Quarantine Act and the regulations appertaining to this Act come under review. The book concludes with a series of fifty "practicums" or schedules for practical work. The selected bibliography refers to 150 titles of recent publications.

M. A. H. TINCKER.

Soil Conservation

Conservation of the Soil

By Prof. A. F. Gustafson. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xvii+312. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 18*s*.

Crop Management and Soil Conservation

By Joseph F. Cox and Dr. Lyman E. Jackson. (Wiley Farm Series.) Pp. xvii+610. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 13*s*. 6*d*. net.

SOIL conservation is as old as, and might indeed be regarded as synonymous with, agriculture. Ancient China, India and Persia knew about it, but during the last century, while great advances have been made in the art of soil exploitation to satisfy the needs of rapidly expanding populations, little attention has been paid to soil conservation, with the result that soil fertility has declined catastrophically and soil erosion has become almost universal. The consequences have been particularly disastrous in the United States, where the imperative necessity of putting back into the soil what pioneer farming took from it is now realized. At the present time, American agriculture is undergoing a fundamental and timely revolution, from which an art, as old as China and as new as the United States, will in due course emerge.

Prof. Gustafson gives a very clear account of the main principles of soil conservation. Little that the ancients did not know and practise has emerged during the renaissance of conservative agriculture, but ancient customs have been greatly modified to suit modern large-scale farming carried out with powerful instruments of destruction. Forests and prairies which under exploitative agriculture were regarded as inefficient forms of land utilization have earned renewed respect as far more efficient soil

conservers and flood controllers than any structure built by man. The evolution of the broad-based from the bench terrace as an efficient instrument for retaining water and soil, while not interfering with mechanized agriculture, is the most original feature of the new soil conservation. Listing, silt-pitting, strip-cropping, rotations are all modifications of ancient practices designed to curb the destructiveness of mechanized cultivation. Conservation of forest land consists essentially in managing the forest on a sustained-yield basis—a practice which comes naturally enough to the real forester but is something of an unwelcome innovation to the lumber baron. In short, the art of soil conservation is to treat the soil kindly, and its practice involves moderation in the use of already existing scientific equipment rather than the application of more science.

Science, however, can take a hand in flood control in badly eroded catchment areas where a highly specialized engineering technique is demanded; but even there it is now recognized that the engineer performs the surgeon's task of keeping the battered patient alive until Nature can complete a lasting cure with trees and grasses. An interesting application of meteorological data is the use of rainfall-intensity frequency charts in determining the design of flood-protection constructions.

"Crop Management and Soil Conservation" is a college text-book of conservation agriculture. The first part emphasizes the need for caution on the same lines as Gustafson describes, the second part tells the student how to farm for a living and possibly also for a profit. It is a straightforward guide to sound American farming. G. V. J.

More Chemical Encyclopædia

Thorpe's Dictionary of Applied Chemistry
By Prof. Jocelyn Field Thorpe and Dr. M. A. Whiteley. Fourth edition. Vol. 2: B1—Chemical Analysis. Pp. xxiii + 712. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 63*s*. net.

THE second volume of Thorpe's "Dictionary" has made its appearance with commendable punctuality. In a foreword, the editors state that they have done their utmost to reduce the space occupied by organic formulæ, although they maintain, quite rightly, that a modern article on organic chemistry must be illustrated by elaborate formulæ. How much more, however, should an article on an industrial process be illustrated by elaborate drawings of plant? Yet these are mainly conspicuous by their scarcity. The new special drawings promised in the foreword appear to be about eleven in number and, of these, eight are small and purely diagrammatic. A cement kiln is allotted far less space than the six formulæ for cedrene and its derivatives, and many of the photographs give no useful information. The outstanding exception is the article on bromine, with ten good drawings reproduced from the Supplement.

The unfortunate choice of the same type for formulæ and the headings of the articles frequently makes it difficult to find a subject, particularly as no spacing is allowed between the end of one article and the beginning of the next, and confusion in reading is caused by the somewhat unusual practice of continuing the subject matter of the first column in the second whenever a table intervenes which reaches across the page.

The greatest defect of the work is perhaps the lack of any kind of index, without which much useful material is bound to escape unnoticed. A brief list of the more important items which do not appear alphabetically under their own headings would take less time to compile than the thirteen-page list of abbreviations of the titles of journals and could be carried on from volume to volume.

The longer articles, largely written by men engaged in industry, are for the most part excellent, although, as is perhaps inevitable, there tends to be a lack of correlation between the number of pages devoted to a subject and its importance—for example, 14½ pages to rice and 2½ to wheat. In a few cases, there is a scarcity of references later than 1930, and an article on chemical affinity, in which 'activity' is scarcely mentioned and 'free energy' not at all, is unusual in 1938. Among much good matter, it is perhaps invidious to select individual contributions, but mention must be made of those on bromine, synthetic camphor, carbolic acid, carbon dioxide, carbon disulphide, casein, celluloid, celluloid plastics (photographic film) and cellulose. All these abound with details which are not readily to be found elsewhere and inspire a feeling of reality.

The shorter items are, as in earlier volumes, clear and concise summaries, with references which form a useful starting point for further investigation. It is not quite clear why some of the halides and sulphides of carbon should have been grouped with phosgene under the heading "Compounds of

Carbon", while carbon tetrachloride and carbon disulphide are treated separately and the technically important dichlorodifluoromethane is omitted altogether. The avoidance of such grouping would materially assist the reader.

The article, "Chemical Analysis", deserves special mention. It is no mean feat to give a fairly detailed account of most of the branches of this subject in the space of 170 pages, but yet it is impossible to resist the feeling that the effort is largely wasted. The first fourteen pages are a paraphrase of the corresponding portion in the 1912 Dictionary, and seem to have been included owing to their historical interest. It does not appear possible otherwise to explain the poorly drawn and inaccurate illustrations, or the advice to fill a steam oven with toluene and to avoid the use of coal gas when making dry tests for sulphur. Electrically heated ovens and the many modern aids to analysis are barely mentioned.

The remainder of the article contains information to be found in most text-books on analysis, but frequently not in sufficient detail to enable an analysis to be conducted without further reference. Many of the interesting new reactions described in the Supplement have been omitted. One of the difficulties confronting the modern analyst is to decide which of several procedures to adopt, but in this respect no assistance is forthcoming. A recommendation by the authors of one particular method would have been more valuable than details of several.

From the reader's point of view, it would have been advantageous to have limited the scope of the article to general and novel methods, leaving further details to be presented under the headings of individual elements. Aluminium, for example, is to be found under "Cobalt Nitrate Reactions", "Special Reactions", "Drop Reactions", "Beryllium", "Aluminium" (with instructions to heat alumina to 1,200° in a sintered glass crucible), "Volumetric Analysis" and "Colorimetric Analysis", in striking contrast to the convenient and admirable summary given under "Aluminium" and noticed in a previous review. The search for an analytical method is not facilitated by the absence of sub-titles at the head of the pages or by the arrangement of the elements in chemical groups for the first hundred pages in contrast to the alphabetical method adopted for the rest. The former is perhaps more scientific, but it is more difficult for the reader who may not have the Periodic Table at his finger tips and may wonder why "uric acid" should be placed next to "silicon".

Only ten pages are devoted to physical methods. The writer on "dielectric constant" (presumably, as an analytical method) has been unable to refrain from a digression into dipole moments, and it is a pity that space could not be found for a table of *raies ultimes* in the excellent account of the analytical applications of spectroscopy.

It cannot be denied that this is an interesting and valuable book. Whether it is worth while for those who already possess the last edition and supplements to purchase the volume is a matter for individual decision. H. E. W.

Structural Evolution of Southern California

Structural Evolution of Southern California
By R. D. Reed and J. S. Hollister. Pp. xx+157. (Tulsa, Okla.: American Association of Petroleum Geologists; London: Thomas Murby and Co., 1936.) 2 dollars; 9*s*.

THE problem of structure of the Coast Ranges of California is by no means new. In fact, ever since the middle of the last century, when the first geological expedition went to California, it has been a subject of interest. Since the discovery of oil in Southern California, this interest in structural complexities has naturally been considerably enhanced. As a result, the State Mining Bureau and the United States Geological Survey have sponsored a great deal of survey work in this territory. Nearly the whole of Southern California has been mapped in detail, and widely differing theories on structure have been advanced from time to time, many of which have been published.

R. D. Reed and J. S. Hollister, in the book under notice (in a sense a sequel to "Geology of California" wherein only casual reference was made to structural evolution), have made use of all published bulletins, papers, maps, charts, etc., available to them. No claim is made that all the opinions expressed are original. Their work has rather been the collection, correlation and sifting of all data, and an expression of views they have come to believe as a result of this spade-work.

On the problem of essential structure, the authors are impressed with the belief that post-Jurassic structural evolution has been dominated by distribution of fundamental basement types. Distribution of these types indicates that Southern California was divided in Lower Mesozoic times into six major palæogeographical provinces;

accordingly, names have been adopted or invented for these provinces. The important "Franciscan" deposits appear to have accumulated in typical geosynclines and therefore their underlying "provinces" are designated geosynclines. Contiguous "positive" provinces are given names ending in "ia" as being comparable with hypothetical ancient lands such as "Appalachia" and "Cascadia".

The conclusion is reached that a local orogenic time-law holds good for provinces similar to one another in basement character; ". . . so far as the post-Franciscan history of Southern California is concerned, tectonically comparable areas seem to have been affected at all times by orogenic and epeirogenic forces". Were other regions of similar size and complexity to Southern California classified by the same geologist into tectonic belts, and a sequence of tectonic events for each belt and for the region as a whole worked out, this local orogenic time-law might be more extensively generalized. Decision on this point, however, must necessarily be delayed for some time to come, owing to the volume of work involved.

The above is only one of many interesting suggestions put forward as a stimulus to further investigation of this fascinating problem. Actually Southern California is too small an area to throw much light on major structural problems concerning comparable world-wide tectonic movements, but the results achieved by systematic assembling of data necessary for rational theorizing on Coast Range structure must prove of great interest to those concerned with major geotectonic problems.

The authors are to be congratulated on a text which lifts mere compilation of data to a high plane of scientific interpretation and constructive philosophy. A modest ending, suggesting that every reader may be "inspired to invent better theories for himself and will readily succeed", only serves to sustain the reader's confidence in the soundness of the authors' thesis.

Cellulose

(1) An Introduction to the Chemistry of Cellulose

By J. T. Marsh and Dr. F. C. Wood. Pp. xv + 432 + 18 plates. (London: Chapman and Hall, Ltd., 1938.) 21*s.* net.

(2) Die Chemie der Cellulose:

unter besonderer Berücksichtigung der Spinnfaser- und Zellstoff-Industrien. Von Prof. Dr. Carl G. Schwalbe. Zweite völlig umgearbeitete Auflage. Hälfte 1, Abteilung 1: Die Chemie der Hölzer. Pp. viii + 451. (Berlin: Gebrüder Borntraeger, 1938.) 24 gold marks.

CELLULOSE, the structural basis of the vegetable world and the raw material of the cotton textile industry, has long been the subject of scientific investigation. Within comparatively recent years its chemical constitution, in particular the length of the chain molecule, has been approximately determined, though the view is gaining ground that the properties of normal cellulose only reflect the average characteristics of the ultimate units of cellulose of which it is composed.

The industries which concern cellulose are so numerous and in many respects so different the one from the other that those engaged in them have a variety of problems to study. Nevertheless a good general knowledge of the behaviour of cellulose is the first requisite, and the progress of the last few years, both on the scientific side and in regard to practical application, has enabled a considerable number of facts to be established, including physical data, which will facilitate further attack on the riddle presented by this most remarkable of all natural materials.

(1) This book is sponsored by Sir Kenneth Lee, who affirms that the close correlation of science to the textile industry has already had a profound effect on its development. The authors claim it to be a relatively simple book which may act as a guide to chemists engaged in the cellulose industries. The scope is best judged from the chapter headings—general properties, dispersed cellulose, modified cellulose, cellulose derivatives, constitution and structure. Being intended for experts, it is scarcely readable in the ordinary sense: but is full of informative detail. It cannot fail to be useful, more particularly since the literature of the subject is widely scattered, often in journals which are not everywhere available.

(2) Dr. Schwalbe wrote an important book on cellulose in 1911 which was very rapidly taken up. Various reasons have delayed the production of a second edition until he has retired from active work. A comprehensive text-book of the whole subject in the old German style is now planned in four volumes of which this, the first, deals with wood alone. For those primarily interested it will no doubt be found exhaustive, though, to judge from the references, very little British work has been considered.

Geology of the Tampico Region, Mexico
By John M. Muir. Pp. xix+280+16 plates. (Tulsa, Okla.: American Association of Petroleum Geologists; London: Thomas Murby and Co., 1936.) 19*s.* 6*d.*

KNOWLEDGE of the geology of the Tampico region of Mexico has been gradually amassed over a period of years by geologists and others interested in the development of its oil resources. In 1928, an attempt was begun to collect and correlate information from various fields and this work proceeded intermittently until 1934, when it was decided by the Executive Committee of the American Association of Petroleum Geologists that the results should be published in a separate volume. When it is realized that hitherto no attempt had been made to assemble and present in book form existing knowledge of the geology of that region, it will not be difficult to assess the value of this work, particularly to future workers in the oilfields.

The first half of the book is concerned with stratigraphy and palæogeography of the region. Rocks outcropping in the Tampico Embayment range in age from Middle Cretaceous to Miocene, while beyond its northern and southern limits Palæozoic and Jurassic rocks are found. Descriptions of all the formations encountered are given in considerable detail. The latter half of the book is devoted to an account of structural features of the northern oilfields situated on the southern prolongation of the Sierra Tamaulipas anticline and the Southern Oilfields which extend from about 43 to 90 miles south of Tampico. Main occurrences of oil are described and attention directed to particular characteristics of individual pools caused not only by structural differences but also in most cases by slight facies-changes in the sediments. Throughout the major period of exploitation the southern fields were considered economically to be of far greater importance than the northern fields, but since 1933 this assessment has been reversed. In the appendixes valuable data are given on oilfield temperatures, well pressures, their stripping, shooting and acid treatment. Finally, there is an excellent bibliography of Mexican oilfield geology which, together with the text of the book, forms a useful record of the advancement of geological knowledge in this region during recent years.

The History of the Telephone in the United Kingdom
By F. G. C. Baldwin. Cheaper edition. Pp. xxvi+728+75 plates. (London: Chapman and Hall, Ltd., 1938). 15*s.* net.

THE reprint of this history is the same as the first edition of 1925, but it may usefully be recalled that the author brings together representative material relevant to the development of the telephone service in Great Britain from the invention of the telephone more than sixty years ago until 1912, when the main body of the telephone system was brought under the unified control of the State, with details of machine-switching and long-distance telephony up to 1922, which preceded the inauguration of unified control of international telephony by a consultative committee. The author, sponsored by Mr. Frank Gill, chief engineer of the National Telephone Company between 1902 and 1913, modestly claims that he has prevented historical material from straying, but he has certainly anticipated what he expects a later writer to do, critically to describe the problems of exploitation of an invention in many respects still similar in essentials to its original form, and draw lessons from a balanced view of the past.

Telephony in Great Britain was from the first parochially conceived, harshly restricted by legislation, and hidebound by patents; can we or can we not blame the powers that were for not realizing that telephony was to become a powerful public service and treating it accordingly? A parallel history could be written around the supply and distribution of electric power, which is yet to be straightened out. The present rapid increase, as compared with other countries, in both the use of telephony and the consumption of electric power, can be traced to our backwardness following early restriction. That history can teach lessons to authorities is illustrated by the fact that the present radio-relay services are to be taken out of the hands of private companies in the next year or so, before their development gets out of control. L. E. C. H.

Adventures with Living Things:
a General Biology. By Elsbeth Kroeber and Walter H. Wolff. Pp. xiii+798. (Boston, New York and Chicago: D. C. Heath and Co.; London: George G. Harrap and Co., Ltd., 1938.) 1.96 dollars.

THE teaching of biology is still in the experimental stage in Great Britain; and, as shown by the large number of good American texts on the subject, there is much to be learned from the methods adopted in other countries, especially the United States. The book under review is a case in point. For in it, a wide, though general, survey of the plant and animal kingdoms is made, the 'type system' is disregarded, and there is no suspicion of dividing the subject into the two sections, botany and zoology. Most authoritative surveys and reports on the teaching of biology, including the recently issued report of the Spens Committee, are agreed that the best approach to the subject is through natural history: and this is the method adopted in this book. The authors have shown breadth of vision, and their text is supported by nearly five hundred excellent illustrations, mostly photographs—which are desirable in the early stages of teaching.

Part 1 approaches the subject through natural history, and is a descriptive account of living things. Part 2 is the functional approach, and deals with the way organisms live and reproduce. Part 3 considers the great generalizations of biology, such as unity in organisms, heredity, evolution and human betterment through biology.

The scientific attitude is inculcated and the scientific method adopted throughout by periodic insertions of practical work, problems for class discussion, supplementary activities for the biological novice and bibliography.

The book can be recommended as a guide to the teaching of biology in Great Britain.

Forest Protection

By Prof. Ralph C. Hawley. Pp. ix+262. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 13*s.* 6*d.* net.

THIS book consists of part of the material originally included in the author's "Practice of Sylviculture" considerably extended. To some extent, the outline follows European standard works. A notable departure, which in connexion with the United States is readily comprehensible, is that something near one half (117 out of 247 pages) of the book (Chapters viii–xiii) is devoted to forest fires, their suppression, control and so forth.

In the minds of some American authors, there would appear to be doubt as to the borderlands separating different branches of forestry science. It is, of course, obvious that to a varying degree they must run the one into the other. It is therefore all the more necessary that the writers of text-books should reach as clear an understanding as possible in this matter.

Surely since the work in question is entitled "Forest Protection" it was unnecessary for the author to write in his preface "This book is not intended to be an engineering or administrative manual for any of the phases of forest protection". The trained forester will understand the meaning underlying these words, but in the case of a book for the student of forestry they appear out of place.

The book is not illustrated. It is to be hoped that in a subsequent edition the author will supply this want since illustrations are almost essential for the student.

A Text Book of the Differential Calculus

By S. Mitra and G. K. Dutt. Pp. xiv+302. (Cambridge: W. Heffer and Sons, Ltd., 1937.) 10*s.* net.

THIS book has been written to supply the special needs of teachers and students in Indian universities. The authors have aimed at making the subject clear to the ordinary reader equipped only with an elementary knowledge of algebra and trigonometry. The foundation is well laid in the early chapters, which are devoted to a full and lucid discussion of variables, bounds, limits, continuity and infinitesimals. This part may provide rather stiff reading for beginners; but the time spent on it will, as the authors point out, "lead to a much better comprehension of the essential principles of the calculus". There follows a rigorous development of the standard results connected with the differentiation of functions of a single variable, leading to a consideration of the chief properties of infinite series and their convergence, maxima and minima, implicit functions and changes of variables. The latter part of the course is devoted mainly to the applications of the principles of the differential calculus to geometry, and, in the selection of the examples, a careful consideration has been given to the needs of students not only of pure mathematics, but also of engineering and the natural sciences.

The text throughout is rigorous, lucid and up to date and is well illustrated both by clearly drawn diagrams and skilfully chosen exercises.

Exposés de Physique atomique expérimentale

6: Spectrographie de Masse; les Isotopes et leurs Masses. Par Louis Cartan. (Actualités scientifiques et industrielles, 550.) Pp. 91. (Paris: Hermann et Cie., 1937.) 20 francs.

THE author's own researches in the field covered by this volume enable him to discuss with both brevity and thoroughness the technique and results of the new spectrometry and to show their bearing on such questions as the energy and stability of the nucleus. The first part treats of the masses and the methods and instruments used in measuring them, from that of Aston of 1927 to the double-focusing ones of the present day. The second deals with isotopes, including those of artificial radioactive substances, their detection and measurement, and the third with the principal numerical relations, such as that of the mass to the charge of the nucleus, and the even and odd law, which have been discovered among the 260 isotopes at present known. The volume is well supplied with plates, figures, numerical tables of results, and a bibliography brought well down into 1937.

Physics for Technical Students in Colleges and Universities

By Prof. William Ballantyne Anderson. Third edition. Pp. xi+807. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 24*s.*

THIS is the third edition of the author's book and shows the result of long teaching experience in American colleges. The entire manuscript of the new edition has been carefully revised by the author and his engineering colleagues; and many new diagrams and problems have been introduced. The superiority of the metric system is recognized, but the British engineering system, in which the 'slug' is the unit of mass, is frequently used and is recommended to students. It may be pointed out that Henry Cavendish, who weighed the earth, was a younger son of Lord Charles Cavendish, and is not correctly described as 'Lord Cavendish'. The chapters on rotary motion and on uniform circular motion deserve special commendation, and the whole book should serve its purpose admirably.

Handbuch der biologischen Arbeitsmethoden

Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 467. Abt. 5: Methoden zum Studium der Funktionen der einzelnen Organe des tierischen Organismus, Teil 10, Heft 7. Allgemeine und vergleichende Physiologie. Pp. 1235-1474. (Berlin und Wien: Urban und Schwarzenberg, 1938.) 13 gold marks.

THIS section contains articles on light-sources for physiological purposes and on methods of measuring and recording electrical changes by M. Wreschner, on the mechanical disintegration of tissues by M. Behrens and on chromatographic analysis by A. Winterstein.

The Swanscombe Skull*

IN view of the importance of the discovery in 1935 and 1936 by Mr. Alvan T. Marston of two bones of a human skull, associated with implements of Acheulean type, in Pleistocene gravels of the Barnfield pit, near Swanscombe, Kent (*see* NATURE of October 19, 1935, p. 637, and August 1, 1936, p. 200), a research committee was appointed by the Royal Anthropological Institute in 1937 to examine and report on the discovery in all its aspects. Further excavation was carried out on behalf of the Committee by Dr. M. Aylwin Cotton of the Institute of Archæology, the cost being borne by a grant of £50 made by the Council of the Royal Society. Publication of the report has been assisted by the Trustees of the British Museum.

The findings of the Committee are based upon reports by specialist members of the Committee, which appear as chapters, ten in number, in the report, and following a general description of the site, deal respectively with geology, palæontology, archæology, including an account of the further excavations contributed by Dr. Cotton, correlation of the deposits, the general features of the bones, their form, and the endocast of the brain.

The Barnfield pit, which is situated about half a mile to the north-west of Swanscombe, between Dartford and Gravesend, has long been famous as a rich source of the implements of palæolithic man and of the remains of Pleistocene mammals; but no human skeletal remains had been found previously. This is also the first occasion on which human remains have been found definitely in association with an Acheulean industry not only in Britain, but in Europe generally.

The deposits belong to the Boyn Hill or 100-ft. terrace of the Thames. A uniform stratification makes it possible to recognize local sub-divisions, in sequence from above downward, of upper gravel and hill wash, upper loam, middle gravel and sands, lower loam, and lower gravel. The deposits lie in a channel, running from west to east, cut in the chalk and Thanet Sands. A subsidiary channel, or possibly scour, containing false-bedded gravel, has cut down through the lower middle gravels through the lower loam to the lower gravel. The two cranial fragments were discovered in an obliquely bedded gravel in this subsidiary channel. This seam is the lowest member in a series of eight similar seams between the lower middle gravel and the upper middle gravel series. The bones are unquestionably indigenous to the series.

The fossil mammalian remains, of which the examination by Mr. M. A. C. Hinton is not yet complete, include, according to a tentative identification, *Elephas antiquus*, *Rhinoceros hemitoechus*, *Bos primigenius*, *Dama clactoniana*—a species at present known only from Britain—and *Equus caballus*—a fauna predominantly of a woodland type, and of an interglacial facies.

A report on the stone industries by Mr. C. F. C. Hawkes, with the co-operation of Dr. K. P. Oakley and Mr. S. Hazzledine Warren, enters into a detailed analysis of the content of each stratum. This analysis is of importance not only as fixing definitely the place in the cultural series of the implements associated with the human remains, but also for its examination of the attribution suggested by Mr. Marston of the industries of the lower and lower middle gravels to the Chellean, or Abbevillian industry, as it is now termed.

The cultural succession, as determined by the report, definitely rules out the Abbevillian attribution, assigning the industry of the lower gravels to Clactonian II, but somewhat prior to Clactonian II of the type site. The lower loam is sterile, such implements as it contains showing evidence of exposure, and evidently having sunk through. The industry is still Clactonian, though of a somewhat more advanced type than that of the lower gravels. The industry of the lower middle gravels is characterized by the number of hand-axes. It was formerly (1912) denominated "Chelles or a transition to St. Acheul"; but it is here assigned to Early Middle Acheulean, the Acheulean III of Breuil; while the large number of flakes may be classed as flake-products of the same Acheulean industry. A small proportion utilized still represent the Clactonian tradition.

Mr. Marston here also assigned certain of the hand-axes to the Abbevillian on the ground of the crudity of their workmanship; but it is pointed out that crudity is not necessarily an indication of relative age, and that the industry must be taken as a whole, when its essential unity appears as entirely of the Early Middle Acheulean.

The industry associated with the skull fragments is regarded as belonging to exactly the same culture as that from the lower gravels. Above the oblique seams of gravel, in which the seam containing the skull fragments is the lowest, the channel is filled by a stratum of gravelly silt, over

* Report on the Swanscombe Skull prepared by the Swanscombe Committee of the Royal Anthropological Institute. Reprinted from the *Journal of the Royal Anthropological Institute*, **68**, 1, 1938. Pp. 17–98 + 6 plates.

which the upper middle gravel series continues in the form of horizontally bedded yellow sands, covering the channel and the lower middle gravel surface flanking it. These deposits are not rich in implements, and nothing suggesting an advance in human material culture has been recovered from them. The yellow sands are uniformly sterile and the skull layer is thus well insulated against conflation with any subsequent cultural development. This is reinforced by the upper loam which again is sterile; and only from the top surface have any further implements been obtained. Such flakes and hand-axes as are yielded by the upper loam show that at this stage the culture prevalent at Swanscombe was still Acheulean. Some advance is suggested by 'sub-cordate' or 'sub-ovate' types; but they have never yet been found *in situ* in the Barnfield pit. A sign of real innovation are the primitive 'tortoise' cores associated with hand-axes in Rickson's pit, in which the earliest stage of the Levallois industry has been recognized. The whole evidence from the overlying strata confirms the inviolable association of the skull with a pure Early Middle Acheulean industry, which already, on the evidence of the artefacts alone, had been assessed by Breuil as Acheulean III.

Dr. K. P. Oakley discusses the correlation of the deposits. The gravels of the 100 ft. terrace must be diagnosed as interglacial and as younger than the Lower Chalky Boulder Clay. This is supported by the fauna and the glacial erratics. From the geological and archæological evidence no doubt can arise that the middle gravels are older than the main Combe Rock stage. If the industries correspond with Middle Acheulean III, in the Somme Valley Middle Acheulean is assigned to the Mindel-Riss interglacial, and it would seem that the middle gravels at Swanscombe must also be regarded as belonging to that period.

The anatomical and anthropological characters of the skull have been examined by Prof. W. E. Le Gros Clark and Dr. G. M. Morant. The fragments found are the occipital and left parietal. Both are nearly complete and articulate perfectly. The individual to whom the bones belonged was probably female and died in her early twenties. In two respects only do they show any significant difference from a modern skull of *Homo sapiens*, namely, in the unusual breadth of the occipital bone and in the thickness of the bone. The endocranial cast shows no feature which serves to differentiate it from the endocranial cast of modern human skulls. The series of measurements fall well within the range of the modern human female skull. The estimated cephalic index is in the neighbourhood of 78 and the cranial capacity 1,325 c.c., which would be unexceptionable in a modern female skull. The missing parts of the skull, however, might have been so formed as to provide clear evidence of differentiation from modern man.

McDougall's Experiments on the Inheritance of Acquired Habits

IN a series of papers extending over a period from 1926 until 1938, Prof. William McDougall brought together evidence which led him to suppose that the hypothesis of Lamarck concerning the inheritability of acquired characteristics is substantially correct.

In designing his experiments, McDougall kept in mind two principles which previous investigators have overlooked. These are, first, that "the adaptation investigated should be achieved by the intelligent purposive efforts of the organism concerned", and, second, that it should be of such a nature that slight degrees of adaptation should be measurable, for it has already been shown by Lamarck's opponents that acquired characteristics are not transmitted as "perfected wholes of structure or function". Hence, if Lamarckian transmission is to be found at all, it should be looked for as some "slight increase of facility in the acquisition of the modification acquired by the parent". Many generations would probably be necessary, therefore, before any very marked changes appeared.

White rats were chosen as subjects for this experiment since it was possible to obtain an initially pure strain (Wistar), and since the breeding habits of rats allow a large number of generations to be studied in a reasonable length of time. A preliminary experiment showed deterioration in performance with successive generations, due, apparently, to an increasing fear of electric shock. The final form of the experiment, therefore, was designed to develop such a phobia. To this end, an apparatus was constructed consisting of three parallel alleys, the central one serving as an entrance and the outside ones as exits to a platform. The apparatus was filled with water, and the motivation was escape from the water to a dry platform. Of the two exit alleys, one, the shocked pathway, was brightly illuminated while the other, the free pathway, was kept dim. The task confronting the animals, therefore, was to escape from the water

through the dim alley, the 'error' of choosing the bright being punished by an electric shock of tetanizing strength. The strength of the shock was varied from animal to animal to obtain this behavioural effect with all of them, and tetanization lasted for three seconds. To avoid position habits, the 'correct' alley was alternated from left to right of the central. This alternation technique, however, allows no control of any alternation habits adopted by the rats. Rats were placed in the apparatus in batches of about six at a time and were given six trials daily. The primary measure of any Lamarckian inheritance was the total number of errors made in reaching a criterion of mastery of twelve successive errorless trials, though note was also taken of any pre-training preference for the dim path.

McDougall's conclusions rest, in the main, on the results obtained with three groups of rats, an experimental group (or Tank group), a control group, and an experimental group obtained by adverse selection from the control stock. The Tank rats were originally obtained from Wistar stock, and subsequent generations were obtained by mating trained members of this stock according to a random selection. The only conscious selection of breeding stock was in the rejection of obvious runts. The control stock does not show the same continuity and inbreeding. McDougall's early intention was to use half the original Wistar stock as controls and breed from members trained in some task other than that of the experimental group. This stock, however, seems to have been abandoned, and subsequent controls were obtained direct from the Wistar Institute, or, in some cases, from other laboratories. The adversely selected experimental group represents an attempt to balance any unconscious favourable selection in the Tank rats by breeding from the worst animals in each generation.

The results with the Tank rats show a progressive improvement from generation to generation, until by the thirty-fourth, the average total number of errors per rat had decreased from an estimated 120 for the first generation (McDougall's records are incomplete before the fourteenth), to 36 for the thirty-fourth. This improvement in error scores seems to be correlated with an increase in timidity, cautiousness or hesitancy. 'Normal' learning shows an initial period of rapid, chance reactions, followed by a pre-solution period of hesitancy with oscillations from one exit to the other. This hesitancy developed earlier in the training period with successive generations of Tank trained rats, and is regarded as the probable cause of the decrease in errors. The adversely selected stock similarly show a very marked improvement, the total average error decreasing from 215 to 43 in fourteen generations. However, the control groups also show a decrease in errors. Groups obtained from Wistar stock in 1926, 1927, 1930 and 1932 show a decrease from 149 to 102. Admittedly, this decrease is by no means as large as those of the experimental groups, but neither the number of generations tested nor the environmental conditions of the groups are at all comparable. McDougall interprets the improvement in the control groups, which had had little contact with his laboratory and whose only relation with the experimental groups was that they too were Wistar rats, as indicating a probable improvement in the entire Wistar stock, for reasons which he is unable to suggest. The possibility that there was an improvement in his experimental technique should also be taken into account.

McDougall's experiments have been repeated by Crew and Agar, neither of whom have obtained any evidence of Lamarckian inheritance. Both these experimenters have attempted to duplicate McDougall's apparatus, but have changed the procedures somewhat to obtain what they consider to be more trustworthy results. Thus, Agar standardized the strength and duration of the shock, and abandoned McDougall's group method of experimenting in favour of the more usual individual trials. Crew, on the other hand, retained the group method and used McDougall's tetanizing criterion of the strength of shock, but introduced marked changes in training, giving his animals a hundred trials before the introduction of shock instead of McDougall's six. All these changes, however, though likely to produce marked changes in the rate of learning of any given group of rats, should be relatively unimportant in producing different rates of learning in successive generations, provided the same technique is rigidly adhered to throughout any given experiment.

Explanations of McDougall's results as due to variations in the strength of shock used imply a gradually increasing strength with successive generations. Since there is no evidence either that such a gradual increase did take place, or that the rate of learning is affected by such small variations as would be necessary with each generation to keep within the limits of variation admitted by McDougall, such explanations cannot be regarded as satisfactory.

Other criticisms have, in the main, accepted McDougall's technique as sufficiently consistent throughout the experiment, but have endeavoured to explain his results in terms of factors other than that of the inheritance of acquired characteristics. One obvious criticism, advanced by Sonneborn and Agar and examined by Crew, is that McDougall unwittingly selected the brightest animals in his experimental group for breeding. That this is

possible in apparently random selection is known to everyone who has worked with animals for any period. However, Crew was satisfied that in his case there was no such favourable selection and thinks it unlikely, therefore, that there would be in McDougall's experiment, and, furthermore, McDougall specifically controlled for such selection in his group of adversely selected animals. The fact that these animals also gave evidence of increased facility with successive generations makes it relatively unimportant whether or not there was favourable selection in his Tank rats.

Both Agar and Crew have criticized McDougall for failing to maintain adequate control groups in his experiment. Agar points out that over a long period of intensive inbreeding there may be progressive changes in the general constitution of the animals, and that such changes might facilitate the performance of McDougall's task. Since all these experimenters agree that less vigorous animals learn more quickly on this task, this criticism may be valid. McDougall states in answer to it, that he observed no such progressive change, but the only really satisfactory control would be the maintenance of a group from the same original stock, subjected to the same laboratory conditions, and inbred in a similar manner.

Crew criticizes McDougall for not having maintained adequate pedigree charts, so that he is unable to say which of his original stock are represented in his later generations. Crew's analysis of his pedigree and record charts led him to postulate the existence of 'quick' and 'slow' rats, 'quickness' being a Mendelian dominant and 'slowness' a recessive. On these grounds, he explains the improvement in the average number of errors per rat in McDougall's experiment as showing merely an increasing number of 'quicks' per generation. As he further states that a 'quick' may make a poor score owing to the action of numerous chance factors, adverse selection may result in a heterogeneous group of 'slows' and 'latent quicks'. If now unconsciously favourable selection is exerted, the 'latent quicks' may be chosen for breeding, and hence a decrease in average errors could be expected. While it may be that rats do differ in some general factor, especially in some such factor as 'photo-phobia', Crew's explanation of the results of McDougall's adversely selected group seems somewhat improbable, particularly as 'latent quicks' keep appearing for fourteen generations.

None of these experimenters seem to have considered the work of Tryon in breeding 'bright' and 'dull' strains as measured by maze performance, or Krechevsky's analysis of these strains. Tryon has bred rats selectively according to their ability on the California automatic maze, and, in a very carefully controlled experiment, has shown clearly that the offspring of 'bright' parents contain more 'brights' than 'dulls', and the offspring of 'dulls' more 'dulls' than 'brights'. The interesting point here in connexion with Lamarckian inheritance, however, is that both strains, 'dulls' as well as 'brights', became progressively better at learning this maze. Tryon inclines to the belief that increased vigour was responsible for the improved performance, but admits the possibility of Lamarckian inheritance.

Krechevsky has analysed the performance of these strains on various problems, and has concluded that they do not differ in any general factor; that is, 'brights' are not 'brights' on all problems, but rather that the difference is one of specific abilities. 'Brights' are good at maze problems because they utilize 'spatial hypotheses' almost entirely, that is, their reactions are governed by spatial cues, while the 'dulls' use primarily visual hypotheses. This penalizes them on a maze, but might assist them in any brightness discrimination test. On McDougall's test, one would assume that Tryon's 'dulls' would be Crew's 'quicks', because they would be 'photo-phobic' and would react on a basis of the differential illumination of the two paths, while the 'brights' would more readily adopt spatial hypotheses such as position or alternation habits.

The position regarding Lamarckian inheritance of acquired habits, on the basis of these experiments with rats, seems to be as obscure as ever. McDougall and Tryon have obtained evidence of an increased facility on a specific task with successive, trained generations; Crew and Agar, under conditions resembling McDougall's, have obtained no such evidence. The reasons for this discrepancy are not clear from the published accounts. It may well be that faults in the experimental techniques are responsible, and that this particular technique will not give trustworthy results concerning inheritance.

McDougall's task is open to criticism on two lines: (1) that an avoidance habit is not really suitable for an inheritance problem, since avoidance reactions are closely knit with such innate factors as fear, timidity, etc., the inheritance of which may certainly not be Lamarckian; and (2) that it provides a very untrustworthy measure of learning ability. All the experimenters who have used it comment on the large element chance plays in producing behaviour which meets the criterion of learning adopted. Crew, in fact, states that thirty-nine of his animals never received a single shock, and, therefore, obviously cannot have 'learned' the differentiation. Others may satisfy the criterion merely by adopting an alternation habit which happens to coincide with the alternation

of the 'correct' alley. If they get 'out of step' they may then make 100 per cent errors. That such an occurrence is possible betrays a poor experimental technique, and raises serious doubts as to the validity of any results obtained with it. Furthermore, the practice of allowing animals to escape by the 'wrong' alley, differentiating it as an error merely by the presence of shock, is poor from the point of view of speed of learning, and trustworthiness of results. Apart from the chance factor as to when and how often the animal encounters both conditions of escape-shock and escape-no-shock, a violent shock can produce marked neurotic symptoms, which may result in purely random activity, or may, in some cases, result in a stereotyping of the error. Crew, in fact, gives a vivid description of violent, emotional and purely random activity lasting for as long as a hundred trials resulting merely from one violent shock.

Without enumerating more of such experimental artefacts here, it is obvious that trustworthy comparisons between successive generations would be a very hazardous task where chance factors can have so marked an effect on the rate of learning. Future research would do well to use a more trustworthy task, and to control not only the constitutional factors so rightly emphasized by Crew and Agar, but also that type of factor shown by Krechevsky to be responsible for the differentiation between Tryon's strains. G. C. DREW.

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Obituary Notices

Dr. Calvin B. Bridges

THE untimely death of Dr. Calvin B. Bridges, of the California Institute of Technology, on December 27, a fortnight before the fiftieth anniversary of his birthday, will be deeply mourned by the many who appreciated his work and his personality.

One of the foremost in the iconoclastic work of creating the modern science of genetics, in the place of what passed as the 'classical' points of view in that field, Bridges was notable also as one who approached the wider problems of life in a spirit as rationalistic and as unfettered by traditional dogma as that in which he dealt with his own speciality, and although he held no teaching positions, his influence in the suffusion of this attitude was considerable.

Bridges was brought up in a small town in the wilds of Northern Lake Champlain, in a family of very moderate means, of pre-revolutionary American stock (including even an American Indian strain). At Columbia College he naturally gravitated into scientific lines and, although he was hampered by the need of earning money while studying, both for the support of himself and, very soon, of a family, his initiative and ability won him in 1910, while yet an undergraduate, a position as personal assistant to Prof. T. H. Morgan in the work which the latter was just beginning on *Drosophila melanogaster*. Bridges' chief task here was to look for and test mutations, and practically his entire career has been an expansion of this work, in which he quickly became the leader. Almost immediately the work proved to be the beginning of a new trail. It became Bridges' passion to follow out this new trail logically everywhere it led, and to work and rework it until it became a broad highroad with many branches, opening up hitherto unsuspected territories. Often the results thus arrived at were in conflict with older beliefs, based on less exact evidence, and in ruthlesly brushing aside the latter he naturally aroused the opposition of those who could not abandon the older modes of thought.

Bridges carried out the same kind of process in regard to the more general problems of the time and in his own personal living, thereby suffering considerable misunderstanding and antagonism on the part of others, which hampered him in the pursuit of his profession. But he always remained true to his own concepts and ideals and did not dissimulate. His open designation of himself as "atheist" in "Who's Who in America" and his opposition to the invasion of the Soviet Union by the Allies shortly after the Great War illustrate his uncompromisingness where his theoretical convictions were concerned, and his lack of faith in prevailing doctrines and institutions. In place of the latter, however, he substituted an ardent belief in the success of future human co-operation, in matters social and economic, and in the radical application of physical and biological science, including genetics, to human affairs.

Through the remarkably energetic and methodical character of his scientific work, including such an apparently trivial but effectively revolutionary change as the introduction of the binocular microscope for the examination of *Drosophila* material, he succeeded in

finding considerably more spontaneous mutations than all other *Drosophila* workers together. He made it his duty to determine the place, in the genetic scheme, of all the changes which he found, and continually to refine upon the conceptual system which they constituted and which, as his work helped to prove, represented the actual material plan of the germ plasm. It was in the course of this systematic testing that he happened, one after another, upon that series of unusual cases which proved to be, not mutations in individual genes, like the rest, but abnormalities of whole chromosomes, of chromosome parts, and of entire sets of chromosomes, and which served as the starting point of most of our modern knowledge of 'chromosome mutations'.

The first of these great contributions of Bridges to genetics was his discovery of non-disjunction, first of the sex chromosomes (1913, 1916) and later of the fourth (1921), together with his working out of its mechanism and of its cytology. It was the striking visual demonstration of the chromosome theory of heredity thus provided which first convinced Bateson, and along with him many other sceptics, of the truth of this theory as a whole. But at least equally important, in its actual pushing forward of our genetic knowledge (as distinguished from the confirmation of things for which cogent evidence really existed already), was his discovery and working out of cases of deficiency (1915, published 1917, *et seq.*) of a part of a chromosome, and of the first translocation (1918, published 1919, *et seq.*). His discovery of triploids (1921), with its proof of the then disputed idea that sex determination depends upon the relative doses of interacting genes, opened up new chapters in our understanding not only of sex determination but also of the manner in which genes in general exert their effects. While in the interpretation and in the planning of the attack on all these cases he enlisted the forces of the whole group of *Drosophila* workers, his initial discovery of the cases, his recognition of the fact that their peculiarities were such as to make them worthy of special studies, and his exemplary prosecution and presentation of these studies themselves, were direct results of that combination of assiduity and intelligence, of method, of painstaking attention to detail, and of following up all clues to their logical conclusions, which always characterized Bridges' manner of working.

In recent years, applying this same meticulousness to the cytological investigation of the giant (multiple) chromosomes of the salivary glands, the possibilities of which had been revealed by Painter (1933 *et seq.*), Bridges, working with renewed vitality on this new branch of the old trail, succeeded in developing amazingly upon the technique and the exactitude of the results; he invented (independently of Koltzoff) the 'polytene' explanation of these chromosomes, and made the important discovery that the remains of 'duplications' produced in past evolution by a process of chromosome breakage and reattachment of parts, similar to that occurring in observed translocations, could still be detected by direct observation in the chromosomes normal to the species. This, and the gathering together and systematization of the multitudinous extant material on *Drosophila* mutations and technique, in the "Drosophila Information Service", constituted the invaluable work upon which he was still engaged at the time of his death.

Bridges suffered more than most men of science from the hardships attendant upon the following out of new trails of thought and action both in his scientific work and in general. But, though in a sense single-minded, he preserved his early freshness of attitude, boyish enthusiasm, sunniness of character and friendliness. He did not let scientific rivalry interfere with his personal friendships, and threw himself into them whole-heartedly and without suspicion. Combined with calculation, he preserved a charming *naiveté*. He was most patient and kind in helping less advanced workers. He was engrossed in his work to a point of absent-mindedness which became a byword to others. His personality was such that it is likely to pass into legend. But his work will undoubtedly form a solid indestructible part of the basic structure of all future biological science.

H. J. MULLER.

Mr. M. A. Phillips

MR. MONTAGU AUSTIN PHILLIPS, the well-known lecturer on natural history subjects, died on January 11, aged fifty-nine years. He had been for many years associated with the British Museum (Natural History) where he acted as a deputy guide-lecturer. Originally he assisted the late Mr. J. H. Leonard, the first official guide-lecturer to be appointed at the Museum, and after Mr. Leonard's death in 1931 he carried on the whole of the guide work until the appointment of the second official guide-lecturer, Miss Mona Edwards, in October 1932. From that time onwards, Mr. Phillips acted as an auxilliary lecturer at the Museum, and was so engaged up to the close of last year, when ill-health caused him to abandon his work. In addition to lecturing in the Museum he had for many years been a well-known lecturer at schools, societies and field-clubs and travelled extensively in connexion with this work. In his lectures, Mr. Phillips had a certain charm of manner which made even the dullest of subjects attractive to his audience, whether it was a large audience at a 'sit-down' lecture or a small group of people in the Museum Galleries.

Mr. Phillips was educated at King's College, London, and was a fellow of most of the senior scientific societies, including the Linnean, Zoological, Geological, Geographical and Royal Entomological Societies; he was in addition a member of the British Ornithologists' Union and was associated also with the Royal College of Organists, being an enthusiastic musician.

GUY DOLLMAN.

Dr. C. J. Gahan, keeper of the Department of Entomology in the British Museum (Natural History) during 1913–27, on January 21, aged seventy-seven years.

Prof. A. Sauveur, professor of metallurgy in Harvard University during 1906–35, aged seventy-six years.

News and Views

Co-operation Between the Nations

On Friday, January 27, there was broadcast in the news bulletin in German sent out by the B.B.C., and again in the news bulletin in English later in the evening, an appeal, signed by eighteen leading men in science, literature, the arts, and medicine in Great Britain, to "men of good will who value the fruits of civilization" to join together to prevent the catastrophe of war. "A spirit of uneasiness broods over the world", the appeal began, and the peoples everywhere, while they know that warfare between modern States can bring no final good, see the armaments of the nations ever growing. It is time for men to break down the artificial barriers of hatred by which they are in danger of being divided, and "to speak across the frontiers to those who feel as they do". The appeal concluded: "We appeal above all to leaders and people in the great German Reich to use those great gifts by which they have for centuries enriched our common heritage in all fields of human knowledge and activity and to join with us in a supreme effort to lay the spectre of war and enmity between nations, and in a spirit of free and willing co-operation, by which alone can their needs and ours be satisfied, to build with us a better future so that we may not only preserve civilization but hand it down to our children enhanced by our experience".

The signatories of this dignified appeal were: Lord Willingdon, Lord Derby, Lord Dawson of Penn, Lord Horder, Lord Macmillan, Lord Stamp, Mr. Montagu Norman, the Right Hon. H. A. L. Fisher, Prof. G. M. Trevelyan, Lord Eustace Percy, Sir Michael Sadler, Dr. Vaughan Williams, Sir William Bragg, Sir Arthur Eddington, Sir Edwin Lutyens, Sir Kenneth Clark, Mr. John Masefield, and Lord Burghley. While the real effect of the appeal, through the medium of the broadcast word, will never be assessed, it cannot be doubted that it will contribute to the promotion of that international good will which all right-thinking men must desire.

National Service in Great Britain

The guide to National Service which has now been issued briefly describes the various civilian services, such as air raid precautions, police, fire services, nursing and first aid, for which volunteers are required, and indicates those for which part-time training in peace time is or is not required. Details are also given of the various branches of the armed forces for which recruits are required and how to join. A Central Bureau is being established by the Ministry of Labour for men and women with professional, scientific and technical qualifications who would be prepared to undertake specialized work in the event of an emergency. The provisional Schedule of Reserved Occupations includes such classes of scientific workers as bacteriologists (25), chemists (21), engineers (25), physicists (25), from the age indicated, and in his introduction to the guide, Sir John Anderson expresses the hope that workers in such reserved occupations will fit themselves for part-time duties such as air raid precautions at their places of work. The guide and the schedule make it clear that the Government is fully alive to the importance of having available a record of men and women with scientific and technical knowledge. It is to be hoped that, should an emergency arise, the Government will see to it that proper use is made of their services.

The late Mr. S. H. Ray

The remarkable record of the late Sidney H. Ray as a student of the languages of the Pacific, which Dr. A. C. Haddon reviews in his obituary notice (see NATURE of January 28, p. 149) is an outstanding achievement of scholarship in adverse circumstances, which has few, if any, parallels in either field investigation or academic study. Not only was Ray compelled to make the work for which he was peculiarly fitted by genius and temperament the secondary consideration of his scanty leisure, but also he laboured in an unmapped field, in which the difficulties would have taxed the energies and powers of concentration even of a student freed from all other preoccupations. The tragedy of Ray's career, however, lay not so much in the conditions in which his studies were pursued, as in the fact, as he himself would have been the first to contend, that through lack of more adequate leisure so much of the unique linguistic knowledge he had acquired, and still more his reasoned conclusions and inferences from that knowledge, have been lost to science and the world. Many years ago, both the Bible Society and Ray's employers, the London County Council, expressed amazed admiration at his vast erudition, but even though the former was afterwards able to make use of his assistance, both bodies expressed regret that they could not offer him the opportunity needed for the development of his powers. When a unique capacity for the advancement of knowledge such as that possessed by S. H. Ray is brought to light, it is surely the duty of the community to see to it that it is not wasted, as undoubtedly it was to a great degree in this instance.

Petrus Camper (1722–1789)

The Faculty of Medicine of the University of Groningen, in collaboration with the *Netherlands Journal of Medicine* and the Netherlands Society for the History of Mathematical and Natural Sciences,

will commemorate in April next the one hundred and fiftieth anniversary of the death of Petrus Camper, physician, anatomist, obstetrician and artist. The name of Camper is perhaps now most frequently recalled in connexion with his contributions to the foundation of craniology as a scientific study. He was the first to make use of the facial angle—an invention apparently of the artist Dürer—as a factor in racial discrimination. The occasion is not without special interest to science in Great Britain, as it was during Camper's visit to London in 1748, through his association with Pringle, Mead and Pitcairn, and his familiarity with the collections of Sir Hans Sloane, Collinson and others that his interest in natural history was stimulated, if not actually aroused. Camper was born on May 11, 1722, at Leyden, where he was educated and took his degree in philosophy and medicine in 1746. He afterwards held professorial chairs at Franeker (1750), Amsterdam (1755) and Groningen (1763), being appointed councillor of State in 1787, two years before his death in 1789. He was among the most distinguished men of science of international standing of his day. Not only was he a fellow of the Royal Society of London, but also he shared with Boerhaave the then unique honour for a foreigner of membership of the Paris Academy of Sciences. His works, of which a collected edition was published in Paris in 1803, covered a wide field, ranging from the physical education of children to detailed studies in anatomy, physiology and natural history. Among his anthropological treatises were studies of the origin and colour of negroes, and on the variation of the facial angle in different races.

Preservation of Wildfowl

AN amendment put forward by the promoters of the Wild Birds (Duck and Geese) Protection Bill has secured the withdrawal of the opposition, on behalf of shore-shooters, which has been holding up the Bill in the House of Commons, and it is to be hoped that it will now have a successful and rapid passage. The amendment provides separate close-times for wild duck and geese above and below high-tide mark; further, the date of the period of prohibition of import of wildfowl will commence on February 1. This last is an extremely important feature of the Bill, for it stops the demand for duck caught in decoys on the Continent during the breeding season. The Bill, which is promoted by the International Committee for Bird Preservation (British Section) and has the full support of the Government, is part of a big international scheme to preserve the stock of wildfowl in Europe. The accumulation of adverse effects of modern civilization is having a most serious effect on wild duck and geese. Cold storage, facilities of transport, draining of land, development of arctic areas and over-commercialization by means of decoys are but a few of the factors which are depriving wildfowl of their nesting and resting grounds and causing their destruction on a vast scale. The shooting season is also admittedly too long in many countries. Sweden has already taken drastic steps by prohibiting all shooting in several of its largest provinces, Denmark and Germany have greatly restricted their shooting seasons, and other European countries are alive to the necessity of action to safeguard the general stock of wildfowl before it is too late. The state of affairs in America, where wildfowl have been reduced to a perilously low number, is only too gloomy an example.

Engineering and Social Science

IN a recent address to the Manchester and District Association of the Institution of Civil Engineers on the work of the civil engineer in relation to social and international problems, Mr. R. D. Brown urged that engineers are no better qualified for statesmanship or politics than the medical man, the lawyer, the psychologist, the physicist or the parson. Engineering science has nothing to do with solving the social, economic and political problems of mankind, and the scientific and the political minds and methods of working have nothing in common. While engineers should be mindful of their duties as citizens, they can only engage in politics if they are prepared to give up engineering altogether and devote their time and energy to a new way of life. Mr. Brown is sceptical of the value of the proposed Council of Engineers, and recommends rather that any man of science, whether an engineer or not, who desires to help in this matter to get into touch with the committee of the newly formed Division for the Study of the Social and International Relations of Science of the British Association. The committee will require all the help it can obtain, whether from engineers, chemists, biologists, publicity experts or others. Mr. Brown referred to the importance in thinking about such problems of divesting the mind of all prejudice, superstition and humbug, and of laying aside all preconceived political, social or racial notions. He considered the committee's work might prove to be the most important investigation ever undertaken by the British Association.

Steel Manufacture in South Wales

THE project of a new steel works and rolling mill at Ebbw Vale in Monmouthshire designed on the latest lines and including a hot strip rolling mill for continuous production has aroused considerable interest. The size of the undertaking may be estimated from the fact that the plant cost about ten million pounds, and is designed to give an output of 600,000 tons per annum of tin plate and sheet steel of the highest quality. The raw materials, coal and limestone, are in the immediate vicinity and transport facilities are good. The electrical part of the equipment is very complete. The works have an installed capacity of 250,000 kw. and will consume approximately 200 million units per annum. The Victoria generating station of the former Ebbw Vale Company has been largely reconstructed, but to provide the greatly increased demand of the new plant a grid supply at 132 kv. is brought from the Upper Boat power station, a distance of eighteen miles. The supply of iron ore for the works is obtained from Northamptonshire, and ample coal is obtainable

from the neighbouring collieries. The coke oven plant is designed to deal with 1,370 tons of coal a day, a complete by-product recovery plant being provided. The two blast furnaces have been entirely reconstructed, the output of each being increased to 3,500 tons of pig iron. The molten iron from the blast furnaces is taken direct to the steel works, but any surplus not required at the moment is diverted to a pig-casting shop. The molten metal is first poured into a 1,400-ton mixer, where it is kept in a molten state until it is required to charge the furnaces. The molten steel is discharged from the furnaces at floor level and is cast into ten-ton ingots.

River Control in Great Britain

A BROADSHEET issued by Political and Economic Planning (PEP) deals with the difficulties which regionalism presents to the efficient operation of specialized and technical services, as exemplified in the control of rivers. Already the Ministry of Health, the Ministry of Agriculture and Fisheries, the Ministry of Transport, the Electricity Commissioners, the Board of Trade, the Mines Department, the Home Office and the Development Commissioners are concerned with different aspects of water supply and the control of rivers in Great Britain. The Land Drainage Act of 1930 was a consolidating and amending measure based on the recommendations of a Royal Commission and created some forty-nine catchment areas which cover the greater part of England and Wales, but the process of constituting and reorganizing drainage boards within catchment areas is not yet complete. Navigable rivers are controlled mainly by 51 public bodies, and waterways are owned by the railways and 31 other companies.

IN the even more important matter of water supply, there are at present 782 local authorities and 50 joint authorities supplying, besides 236 companies and 1,053 private proprietors. To secure further rationalization and conservation of water supplies, nine regional advisory committees have been created, and a sub-committee of the Advisory Water Committee recently recommended that other committees should be created in the Greater Metropolitan Area, South Wales and the North-East. The possibility of damage to mains and reservoirs during air raids makes working agreements even more essential. The control of sewage presents yet another problem calling for co-ordination, while there are nearly fifty fishery boards concerned to prevent pollution of rivers, which may come into conflict with the navigation authorities. Moreover, town and country planning schemes are required to prevent ribbon development along river banks and undue pressure to develop sites. It is suggested that the Thames Conservancy Board, which is both a conservancy and catchment authority and has power over pollution and fisheries, is a model of what is required. How far it would be possible to entrust the general supervision of all water interests to one central department is a matter for discussion.

British Museum (Natural History): Recent Acquisitions

THE Trustees have purchased for the Department of Mineralogy uncut crystals of topaz, sapphire, and a set of seven rough crystals of ruby from Mogok, while cut stones are represented by a good example of deep lilac-coloured kunzite and a remarkable clear yellow cassiterite, cut from a stone from Uganda. A small diamond of considerable interest in the history of diamond-mining has been presented by Sir Ernest Oppenheimer. It is the first diamond taken from the first of the Kimberley diamond mines—the Jagersfontein—and was found by William Wreford Paddon. Dr. Stanley Smith, University of Bristol, has presented a specimen of natural coke showing columnar structure, from a quarry near Cockfield, County Durham. The coke was formed where a coal seam had been burnt out by a basalt dyke. Miss Beatrice O. Corfe has presented to the Department of Botany more than three hundred paintings of British flowers. The Department already possesses a number of Miss Corfe's paintings which were purchased some years ago. The paintings are artistic and at the same time botanically sound, and a number of them suitably adapted have been reproduced in the Museum series of botanical picture postcards. As a result of a short expedition to St. Lucia undertaken for the Museum by Mr. Harold E. Box, more than three hundred flowering plants and ferns were obtained chiefly from the higher altitudes of the mountains in the interior of the island. Unfortunately, Mr. Box's visit coincided with the almost unprecedented rainfall of November last, and twenty out of twenty-eight days had to be spent in camp or indoors.

Fisheries Research in Hong Kong

AT the recent meeting of the British Association in Cambridge, the president of Section D (Zoology), in a highly important address, directed attention to the fact that the British Empire as a whole is regrettably deficient in fisheries research and administration. This is especially true of British territories in the Far East. In consequence, highly skilled and intensely industrious Japanese fishermen have in recent years been exploiting practically all the great fishing grounds of the Pacific region and landing large quantities of fish at most of the principal fish-markets—both British and foreign—along the coasts of China, India, Philippines, Malaya and Dutch East Indies. It is highly gratifying, therefore, to note that the University of Hong Kong recently has published a small handbook ("Common Marine Food Fishes at Hong Kong". By G. A. C. Herklots and S. Y. Lin. Pp. 75. Hong Kong: G. A. C. Herklots, The University. n.d. n.p.) written in both English and Chinese, describing forty of the commonest food fishes landed at Hong Kong fish-markets. Each fish has been given its scientific name, Chinese name or names, and an English name—in some instances specially coined for this book. This is followed by a brief but useful description accompanied by a black-and-white illustration, with notes on distribution, seasonal abundance, price and food value. At the end of the book are set out twelve Chinese and seventeen European recipes for the cooking of fish dishes.

As a preliminary contribution to our knowledge of the food fishes of Hong Kong this book is most valuable. It is greatly to be hoped, however, that it merely heralds the inauguration of a much more far-reaching and systematic study of the marine resources of the Hong Kong region, to be undertaken by or under the auspices of the University; or, better still, by a specially built and properly equipped fisheries research laboratory.

The Lighting of the Western World Fair

THE illumination of the San Francisco Panama-Pacific Exposition of 1915 set a high standard in exhibition lighting which was for long unsurpassed. According to an article on the Golden Gate Exposition, which appeared in the *Electrician* of January 20, it will be far surpassed by this new exhibition on Treasure Island in San Francisco Bay which will be opened on February 15. The gem-like appearance of the various buildings is mainly due to the use of an inexpensive insulating material called 'vermiculite'—an alteration of mica expanded by electric heat to fifteen to twenty times its original size. Applied to wet stucco, vermiculite imports an antique finish which scintillates with light. The sea wall and roadway lighting of Treasure Island is designed to be in keeping with the main project, and it is considered that it will establish a new milestone in the history of illumination. Projectors concealed in troughs floodlight the walls in white. Cylindrical golden amber lanterns are spaced on approximately sixty-foot centres along the entire facade for roadway illumination and to break up the flatness of the long lighted wall. Spectacular lighting has been arranged for the Courts of Pacifica and of the Seven Seas. The sculptured relief work consisting of submarine scenes is painted with paints that fluoresce under the ultra-violet light provided by concealed projectors from below. Nearly three hundred ultra-violet mercury floodlights, each of 100 watts capacity, are being used for fluorescence effects on outdoor murals. More than two hundred underwater floodlights are being installed, and altogether the outdoor lighting equipment comprises more than 10,000 units. The interiors of exhibition buildings are uniformly lighted by day and night; they have no windows. At the high points of the main buildings a concentrated type of reflector is employed while at lower points reflectors with layer spread are used. The total illumination of the 400 acre exposition site is estimated to require 40 million kilowatt hours during the 288 days the fair will be open.

Standard Television Terms

Now that television broadcasting has become a public service in Great Britain, it is very desirable that, so far as possible, standardized terms and definitions should be used in connexion with the technique of this subject. The British Standards Institution has already made some progress in the matter in so far as the "Glossary of Terms used in Electrical Engineering" (No. 205–1936) contains two sub-sections dealing with terms used in connexion with television and with cathode ray tubes respectively. More recently, the Radio Manufacturers' Association has given consideration to the desirability of television equipment manufacturers and television engineers using a common form of nomenclature. It has been decided that, so far as possible, the technical terms given in the above Glossary should be used by manufacturers in their literature and in any instruction classes which they may operate. In addition, the Association has compiled a list of titles which are recommended for use in working the controls of television receivers. Fourteen titles are listed and described, and in so far as the modern receiver may have upwards of six hand controls directly accessible to the user, this would seem to be a very sound recommendation. It is understood that the R.M.A. has communicated the above recommendations to technical institutes providing radio engineering courses, with the view of securing their co-operation towards the desired objective.

Marine Engineering Collection

H.M. STATIONERY OFFICE has recently published a new descriptive catalogue (price 2*s.* 6*d.* net) of the Marine Engineering Collection in the Science Museum. Nowhere else is to be seen anything like so large and representative a collection of marine engineering models, drawings, photographs, etc., as that at the Science Museum; and a close study of this catalogue and the companion volume on history and development, will repay anyone with an interest in the subject. Nearly 400 exhibits are described clearly and accurately, and there are 15 plates. Among the illustrations are photographs of the engine built by David Napier in 1811 for Henry Bell's *Comet* and of one set of the main steam turbines of the *Queen Mary*. Both these vessels were built and engined on the Clyde, but some of the most beautiful models in the collection are those of engines built on the banks of the Thames when the names of Penn, Seaward, Maudslay and Field were as widely known as those of the marine engineers of the Clyde and the Tyne are to-day. In connexion with this it is perhaps permissible again to recall the debt of marine engineers to Bennet Woodcroft, who by securing the early engine built by Symington, and that of the *Comet*, laid the foundation of the fine series of exhibits described in this catalogue of marine engines.

First-Aid Services and Air Raid Precautions

FOLLOWING the recent transfer from the Home Office to the Ministry of Health of responsibility for approving the air raid precautions schemes of local authorities in respect of first-aid posts and ambulance services, the Minister of Health has forwarded to all local authorities responsible for such schemes and to every voluntary hospital an explanatory communication (Circular 1764. H.M. Stationery Office. 1*d.* net). There should be at least one medical man, and if possible a trained nurse, in addition to the volunteer personnel, in attendance at every aid post. An aid post should be attached, or be very close, to all hospitals which are to be used for the initial reception of casualties, and some of the smaller hospitals,

clinics, health centres, etc., might be transformed into aid posts. In some areas, it is suggested, the fixed posts should be supplemented by mobile units, which could give medical aid on the spot. Ambulances that may be required, the organization of ambulance services, and their personnel, are described, as well as the use and training of women for ambulance driving. Finally, the Minister urges all responsible authorities to press on with their schemes and proposals without delay, and desires that an interim report be furnished by every authority involved.

The Placing of Children in Families

THE Advisory Committee of the League of Nations has issued a report upon this subject ("The Placing of Children in Families". Geneva, 1938. Vol. 1, price 3*s*.; Vol. 2, price 5*s*. Messrs. Allen and Unwin, 40 Museum Street, W.C.1). To begin with, the Child Welfare Committee of the League planned a survey on the placing of children in families as part of its general inquiry into the treatment of neglected and delinquent minors, but it was afterwards decided to treat independently the whole problem of placing in families as a method of child care. The first volume of this report presents the principles accepted as underlying provisions for child care, the characteristic features of the different systems employed in various countries, and the organization of social services to direct 'placing'. Vol. 2 describes the various systems of placing children in families that are now employed in different parts of the world.

Buildings for the Academy of Sciences of the U.S.S.R.

A LARGE plaster-of-Paris model of the main new buildings of the Academy of Sciences of the U.S.S.R. is now on view at the Academy's premises in Bolshaya Kuluzhskaya Ulitsa in Moscow. The buildings were designed by A. V. Shchusev. The site for the buildings most favoured is on the Frunze Embankment of the Moscow River. The new buildings of the Academy, according to the plans, consist of five blocks with a volume of 880,000 cubic metres. In the centre of the architectural ensemble is the main block for the presidium of the Academy. The hall is large enough to seat 2,000 persons. There are also four smaller auditoriums. Near the main hall are rooms for the demonstration of films and for broadcasting; also a post and telegraphic office and an information bureau. A block has been set aside for the library and storage premises for fifteen million volumes. On either side of the block for the presidium are buildings to accommodate two museums, one of which will be the Natural History Museum.

The Food and Drugs Act, 1938

THE Minister of Health has issued a circular to local authorities and public analysts on the new Food and Drugs Act passed last July, which comes into force next October (Circular 1755. H.M. Stationery Office. 2*d*. net). This Act represents a great simplification of existing food and drugs law, some of which dates back to the sixteenth century, and opportunity has been taken to introduce, into the general law, provisions which have up to now been included only in Local Acts. Among new provisions which will become enforceable are the registration by local authorities of premises used for the sale or manufacture of ice cream and the preparation or manufacture of sausages or preserved food. Ice cream vendors must have their names and addresses on stalls, carts and barrows, and this requirement may be extended to all or any foods by the local authority. Slaughterhouses and knacker's yards will all in future be licensed for limited periods only, and new requirements are laid down as regards rooms, yards, etc., in which food is sold or prepared for sale.

Earth Tremor in the Lipari Islands

A STRONG earth tremor with epicentre near latitude 38° 40′ N., longitude 15° 7′ E. occurred during the night of January 27 and lasted several seconds according to human experience. The shock damaged several buildings, but no casualties are reported. The depth of focus is uncertain, but is unlikely to have been at the surface, as the shock was experienced and caused some apprehension in Messina. Messina has been troubled by earthquakes on several previous occasions, including February 25, 1509, June 8, 1599, March 28 and April 9, 1780, February 5–March 28, 1783 (six altogether), December 28, 1908, September 8, 1905, and October 23, 1907. The one on December 28, 1908, at 5 h. 21 m. was probably the most severe, nearly destroying Messina and Reggio, and causing the deaths of 77,283 people. On that occasion there were two epicentres in the Straits of Messina, the northerly one being the most important. The shock lasted 30 sec., caused sea-waves 38 ft. high at San Alessio, and subsidences of 22·9 in. two miles south of Reggio and 28 in. within two miles of Messina harbour.

The Chilean Earthquake

CHILE is one of the great seismically active regions in the world and part of the circum-Pacific ring of instability. During the night of January 24, an earthquake which lasted according to human experience for three minutes, shook an area greater than 40,000 square miles embracing Talca and Concepcion, and caused the deaths of approximately 15,000 people. It was the most severe for twelve years in Chile and the most destructive of human life since Quetta (India) in 1935. The three towns of Chillan, Pailalleque and Parral are reported completely destroyed; Concepcion, Talcahuano, San Rosendo and Los Angeles are severely damaged, and Talca, Angol, Lota and Curico damaged. At Talca the prison collapsed, fires broke out at the port of Talcahuano, the cathedral tower at Vaparaiso swayed dangerously, and half Concepcion is reported in ruins. From the available macroseismic evidence the epicentre appears to be near lat. 37° S. and somewhat to the east of long. 73° W. The shock appears to have had a normal focal depth and to have caused some surface faulting, and the railway line is reported damaged in several places, including one point about 12 miles south of Talca. Two trains are reported derailed.

CONCEPCION has had an unfortunate history seismically, having been severely damaged on no fewer than six occasions: February 9, 1570, March 15, 1657, July 8, 1730, March 25, 1751, February 20,

1835, and July 23, 1898. The last was the least severe, but the five others were all accompanied by sea waves. On February 20, 1835, Concepcion was utterly ruined. The sea waves were 28 ft. and more in height, causing damage even as far north as Fernandez (420 miles). On this occasion the coast was raised by 4–5 ft., though it afterwards subsided by half that amount. The epicentre on the present occasion is probably farther inland than on former occasions, as most damage appears to have been done to the east of Concepcion and no sea waves are mentioned. The most active epicentre for moderate shocks recently appears to have been lat. 38·0° S., long. 73·5° W., which is a little to the south-west of the one suggested in the present instance, though more precise information concerning this latter must await the records of seismograms at observatories throughout the world.

Announcements

PROF. ARTHUR CONWAY, professor of mathematical physics in University College, Dublin, has been appointed by the Pope a member of the Pontifical Academy of Sciences to occupy the seat left vacant by the late Lord Rutherford.

PROF. P. G. H. BOSWELL, who has just retired from the chair of geology in the Imperial College of Science and Technology, has been appointed emeritus professor of the College.

THE annual award of the Pittsburgh Section of the American Chemical Society has been made to Dr. George H. Clapp. The award, an aluminium plaque suitably inscribed, is made in recognition of outstanding service to chemistry in the Pittsburgh district. Dr. Clapp, who recently celebrated his eightieth birthday, directed, with Captain Hunt, the firm of Hunt and Clapp, which afterwards acquired the Pittsburgh Testing Laboratory. With Captain Hunt, Dr. Clapp was instrumental in bringing to Pittsburgh Charles M. Hall and in organizing the Pittsburgh Reduction Co., which is now the Aluminium Co. of America. Dr. Clapp's hobby is conchology.

SIR FRANK SMITH, who has just retired from the post of secretary of the Department of Scientific and Industrial Research (NATURE, Jan. 14, p. 56), has taken up an appointment with the Anglo-Iranian Oil Co., Ltd., to advise on the company's research and development work.

AN appeal will be broadcast from all national stations of the B.B.C. at 8.45 p.m. on Sunday, February 5, on behalf of UFAW (Universities Federation for Animal Welfare). This body differs from many having kindred objects in that its membership is drawn from the universities and includes a number of distinguished men of science, particularly biologists. The appeal will take the form of a dialogue between "Fougasse", the art editor of *Punch*, and the Hon. Harold Nicolson, M.P.

THE sixth International Congress of the Technique and Chemistry of Agricultural Industries will be held in Budapest on July 10–20.

ELECTION to Beit Fellowships for scientific research will take place on or about July 7. Not more than three fellowships will be awarded. Applications must be received on or before April 6. Forms of applications and further information can be obtained from the Rector, Imperial College, South Kensington, London, S.W.

A SCANDINAVIAN Summer School in Norway and Sweden is being arranged by the Association for Education in Citizenship, to be held during August 5–22. The party will stay in colleges at Bommersvik, near Stockholm, and at Syverud, near Oslo. Lectures in English on the political, economic and educational developments taking place in their respective countries will be given by Norwegian and Swedish experts. Further information can be obtained from the secretary at the Association's offices, 10 Victoria Street, S.W.1.

THE annual joint meeting of the Institute of Radio Engineers and the International Scientific Radio Union (American Section) will be held in Washington, D.C., on April 28–29. Meetings of other scientific societies will be held in Washington during the same week including the National Academy of Sciences, American Physical Society and American Geophysical Union. Papers on the more fundamental and scientific aspects of radio will be presented. The programme will be published in the April issue of the *Proceedings of the Institute of Radio Engineers*. Further information can be obtained from S. S. Kirby, National Bureau of Standards, Washington, D.C.

THE annual malaria control course for laymen will be held at the London School of Hygiene and Tropical Medicine commencing on June 26. The course will be under the direction of Sir Malcolm Watson and the staff of the Ross Institute of Tropical Hygiene. The course lasts five days. It includes instruction on mosquitoes and their habits, drainage and other measures for the prevention of malaria. It is illustrated by lantern slides, films, demonstrations of the living insect in the various stages of its history, and a practical demonstration on Hampstead Heath. Application to attend the course, which is free, should be sent in as early as possible to the Organizing Secretary, Ross Institute of Tropical Hygiene, Keppel Street, Gower Street, London, W.C.1.

THE thirty-first annual general meeting of the Institute of Metals will be held in London on March 8–9. In addition to the usual list of papers to be read and discussed on the first day of the meeting, there will be two general discussions extending over the whole of the second day of the meeting. At the morning session the subject of debate will be "The Effect of Work on the Mechanical Properties of Non-Ferrous Metals", and in the afternoon the discussion topic will be "Industrial Application of Spectrography in the Non-Ferrous Metallurgical Industry". On March 8, the second annual award of the Institute of Metals Medal will be made, the recipient being Sir Harold Carpenter. The medal, which is of platinum, is the gift to the Council of the Institute, which decides its award, of the Mond Nickel Co., Ltd. The first award of the medal was made last year to Sir William Bragg.

Letters to the Editor

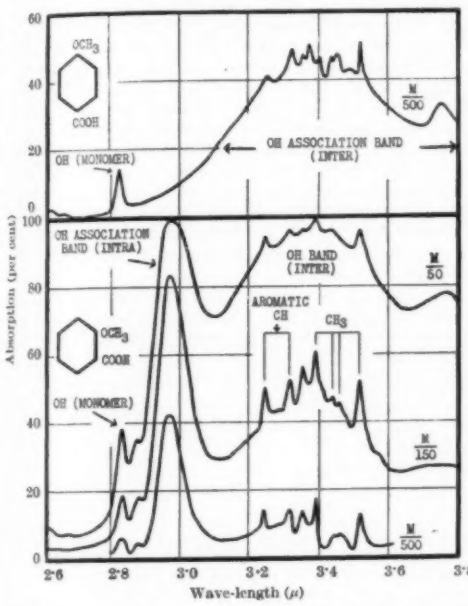
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 207.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A New OH Band in a Carboxylic Acid

RECENT investigations of infra-red spectra in the region of 3 μ by Davies and Sutherland[1], and Buswell, Rodebush and Roy[2], have shown that the COOH group of carboxylic acids has an absorption band close to that given by the OH group in alcohols and phenols[3] (~ 2·8 μ) as well as a large region of absorption at longer wave-lengths. There is, however, an important distinction between the acids and other compounds. While alcoholic and phenolic bodies are generally unassociated in carbon tetrachloride at concentrations of 0·01 mol./l. and lower (compounds such as salicylic aldehyde are exceptions and are completely associated intramolecularly), the acids are much more strongly associated and intense absorption in the association region is found at concentrations so low as 0·002 mol./l. at ordinary temperatures.

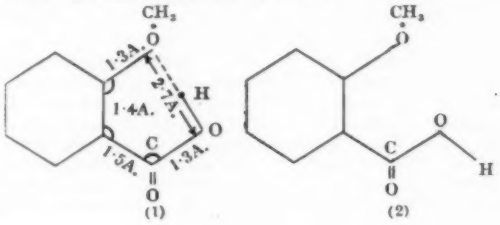


ABSORPTION OF *o*- AND *p*-METHOXYBENZOIC ACIDS IN CARBON TETRACHLORIDE. CELL LENGTH 1 CM. TEMP. 20°C.

It has not yet been shown whether the acid complexes split up completely at still lower concentrations, although the infra-red investigations of Rodebush *et al.*[2], and polarization measurements[4] would indicate its probability. A breaking up of the complexes is fairly easily achieved by working at higher temperatures. The double COOH ring of associated acids has been well established by electron diffraction measurements of Pauling and Brockway[5], and offers a ready explanation of a number of physical properties of carboxylic acids. Thus terephthalic acid, diphenyl-4 : 4′-dicarboxylic acid, and many other dibasic acids have high melting points and are sparingly soluble in most organic solvents. Clearly if the molecules are associated at both COOH groups, the substance will exist in chains of considerable stability and will not easily dissolve or melt. Diphenic acid (2 : 2′-dicarboxylic acid) is quite soluble, on the other hand, and here the contiguity of the two COOH groups makes association into large complexes unlikely.

In carboxylic acids, the OH band is displaced somewhat from the position found in other hydroxylic bodies (2·75 μ in primary alcohols, 2·77 μ in phenol, and ~ 2·83 μ in acids) and at ordinary temperatures the band obtained is very small, while the association band is more intense than with the other hydroxylic bodies and extends over a greater wave-length range, about 3·0 to 4·2 μ (cf. Rodebush *et al.*[2]). The simple doublet structure attributed to this band by these workers in our view requires further investigation, and no one, so far as we know, has yet advanced an explanation of the great width and intensity of the band.

In the accompanying figure we give curves for *o*-methoxybenzoic acid at concentrations of 1/50, 1/150 and 1/500 mol./l., and for *p*-methoxybenzoic acid at 1/500 mol./l. (almost the limit of solubility), both in carbon tetrachloride. It will be observed that the *para*-compound gives the usual carboxylic acid curve, with an OH band at 2·824 μ and an association band at 3·4 μ. The sharp peaks superimposed on the association band are readily identified as being due to CH vibrations of the benzene ring and of the CH_3 group. The *ortho*-compound, in addition to an OH band at 2·833 μ and the usual association band, has a new band of considerable intensity at 2·974 μ, totally distinct from those usually found in acids. It is well recognized that *ortho*-compounds exhibit abnormal behaviour in absorption (cf. Wulf *et al.*[6], and Pauling[7]) and *o*-methoxybenzoic acid is an example of this. The phenomenon seems to indicate the existence in solution of two monomeric forms of *o*-methoxybenzoic acid:



Form (2) will behave like the *p*-acid, while in Form (1) interaction between the oxygen of the methoxy group and the OH of the COOH group will prevent normal association of two COOH groups, and so a strong monomeric OH band should be observed, although with a frequency somewhat slower than that of the unaffected OH. Giving the C—C and C—O bonds the lengths shown in (1) and making the angles indicated all equal to 122°, it is found that the O—O distance is close to 2·7 A., the value accepted for hydrogen bonding. The hydrogen atom need not be exactly in line with the oxygen atoms as shown, although little strain of the normal COH angle would be required for this to be the case.

It will be noted that the association band is smaller in the *ortho*- than in the *para*-compound at a given concentration, and this supports the idea that the new band has formed at the expense of the association band. As is to be expected on this view, the *ortho*-compound is more soluble in carbon tetrachloride than is the *para*-compound (ratio ~ 10 : 1); the latter also has much the higher melting point. The new band bears a strong resemblance to the bands at ~ 2·9 μ found by Errera and Sack[8] for ethyl alcohol and phenol in dioxan, where opportunity exists for a somewhat similar interaction.

The *m*-acid gives an absorption spectrum almost indistinguishable from the *p*-acid.

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Interpretation of Beta-Disintegration Data

FERMI'S original theory of β-decay[1] made a definite prediction as to the energy distribution of the electrons emitted from a β-active element. It was found[2] that the experimental distribution curves did not agree in shape with this prediction in the sense that the number of electrons of low energy (relative to the upper limit of the spectrum) was considerably greater in the experimental than in the theoretical curves. A modified theory was then proposed by Konopinski and Uhlenbeck (K.U.)[3] which introduced in the distribution curve another factor proportional to the square of the momentum of the emitted neutrino. This theory appeared to agree with the facts.

Further experimental evidence, however, revealed a number of facts which did not fit in well with the modified theory: (1) The shape of the observed energy spectra did not fit the K.U. law near the upper limit, but seemed there to follow the original law of Fermi, although the latter did not fit with any other part of the curve[4]; if one determined the position of the upper limit by extrapolation from the K.U. law, one obtained values that were difficult to reconcile either with the observed spectrum or with the other data on the energy balance[5]. (2) The Sargent curves (decay constant against disintegration energy) seemed to agree better with the Fermi theory[4]. (3) The probability of capturing a *K*-electron, as compared to that of emitting a positron, was found to be much smaller than the K.U. theory would predict, but in reasonable agreement with the Fermi theory[6]. (4) An attempt to develop the K.U. theory into a mathematically consistent scheme showed that it was, at any rate, far more complicated than that of Fermi, and no proof has as yet been given that it can be consistently carried further than to the first order of approximation[7].

We therefore investigated the view that the original theory of Fermi correctly represents the elementary law; but that the observed spectra, in so far as they belong to 'allowed' transitions, do not represent the effect of a single nuclear transformation, but rather a superposition of different spectra belonging to transitions to different levels of the final nucleus. It is then clear that the resulting energy distribution will contain rather more electrons of low energies, compared to the upper limit of the spectrum, than a single Fermi curve. If the nucleus is left in an excited state, it must eventually lose its energy by radiation, and the crucial test for the suggested point of view is the presence of γ-rays of suitable energy and intensity from all those radioactive bodies which have 'allowed' transitions and the energy spectra of which are known to be different from the simple Fermi curve. The γ-rays might in some cases be absent because the excited state of the nucleus might be a metastable isomer; but this could not be true for all such elements. The restriction to allowed transitions is necessary because in 'forbidden' transitions the shape, even of a single curve, is affected by more complicated factors[8].

Interpreting from this point of view the electron spectra of ^{12}B, ^{20}F, ^{17}F, ^{13}N, ^{15}O, as given by Fowler, Delsasso and Lauritsen[9], we have estimated the energy and intensity of the γ-radiation to be expected. The results are given in the following table.

Active element	Product nucleus	Energy of γ-ray in Mv.	Number of γ-quanta per disintegration
^{12}B	^{12}C	5	0·5
^{20}F	^{20}Ne	2	0·7
^{13}N	^{13}C	0·27	0·8
^{15}O	^{15}N	0·5	0·4
^{17}F	^{17}O	0·9	0·6

No great accuracy is claimed for these results since the curve-fitting is very sensitive to the high-energy ends of the electron spectra, which are not very accurately known, and also because we have assumed that only one excited level is involved, whereas there might be more.

The presence of a γ-ray accompanying the disintegration of ^{12}N was indeed reported by Richardson[10], who gave its energy as 0·3 Mv. A γ-radiation from ^{20}F was reported by Burcham and Smith[11], and measurements of the energy of this radiation, which are being made by Bower[12], indicate a value of about 2·2 Mv. Although γ-radiations of the predicted energies from the other elements of our table have not been reported, it is interesting to notice that an energy level in ^{17}O at 0·83 Mv. is known to exist, since it is excited in a number of other nuclear reactions[11,13], and similarly an excited state of ^{13}C at 4·3 Mv. is known[13]. We are indebted to Mr. P. I. Dee for this discussion of the experimental data.

Finally, we would like to point out that, although one cannot consider the above evidence as convincing confirmation of the point of view we suggest, it is certainly incompatible with the K.U. theory, since

the existence of γ-rays shows that the observed curves must be superpositions of at least two simple spectra, whereas their shapes are not such as could be represented as sums of two K.U. curves with end-points differing by the energy of the γ-rays.

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A New Form of the Baryteron Equation and Some Related Questions

IT is known that the 2-component *spinors* introduced by Van der Waerden must be completed to 4-component quantities if linear transformation of their components by the complete Lorentz group including reflections is required. These quantities, often called 'Dirac wave-functions', will be called here 'four-spinors' or '*undors** of the first rank'. Defining the reflection in the right way[1], it is possible to join to every four-spinor ψ another four-spinor[2] $\psi^{\mathfrak{E}}$, the components of which are linear combinations of those of ψ^*. This $\psi^{\mathfrak{E}}$ is called the *charge-conjugated*[3] of ψ. For if ψ is a solution of the Dirac equation for a positive particle,

$$mc\psi = \beta\{\mathfrak{e} - (\vec{\alpha}.\vec{\pi})\}\psi,$$

$$c\mathfrak{e} = i\hbar(\partial/\partial t) - e\varphi, \quad \vec{\pi} = -i\hbar\vec{\nabla} - (e/c)\vec{A},$$

then $\psi^{\mathfrak{E}}$ is a solution of the Dirac equation for a negative particle:

$$mc\psi^{\mathfrak{E}} = \beta\{\mathfrak{e}^L - (\vec{\alpha}.\vec{\pi}^L)\}\psi^{\mathfrak{E}},$$

$$c\mathfrak{e}^L = i\hbar(\partial/\partial t) + e\varphi, \ \vec{\pi}^L = -i\hbar\vec{\nabla} + (e/c)\vec{A};$$

vice versa ($\psi^{\mathfrak{E}\mathfrak{E}} = \psi$). Four-spinors, which are equal to their own charge-conjugated, we may call *neutrinors*. These quantities, which are equivalent to a two-spinor together with its complex conjugated, are not only useful in the so-called neutrino theory of light, but also Majorana's theory of *neutrons*[4] may be summarized by stating that the quantized four-spinor of a neutral particle is a neutrinor.

An *undor-calculus* analogous to tensor-calculus and Van der Waerden's spinor-calculus can be developed. An undor of the second rank $\Psi_{k,k'}$ ($k,k' = 1, 2, 3, 4$), that is, a quantity transforming like the product of two four-spinors, may be regarded then as consisting of a scalar, a pseudo-scalar and a pseudo-4-vector (the antisymmetrical part of $\Psi_{k,k'}$) and a regular 4-vector with an antisymmetrical tensor (its symmetrical part). So Kemmer's baryteron* field[5] can be represented[6] by one single symmetrical undor ($\Psi_{k,k'} = \Psi_{k',k}$). Denoting by ψ_P and ψ_N the wave-functions of protons and neutrons and by $\vec{\alpha}$, $\vec{\beta}$ and $\vec{\alpha}'$, $\vec{\beta}'$ the Dirac matrices operating on k and k', the baryteron equation[5,7,8] is given in the following simple form:

$$2m_0c\{\Psi_{k,k'} + 2if_{\mathrm{op}}(\psi^{\mathfrak{E}}_{Nk}\psi_{Pk'} + \psi^{\mathfrak{E}}_{Nk'}\psi_{Pk})\} =$$

$$\beta\{\mathfrak{e} - (\vec{\alpha}.\vec{\pi})\}\Psi_{k,k'} + \beta'\{\mathfrak{e} - (\vec{\alpha}'.\vec{\pi})\}\Psi_{k,k'}. \qquad (1)$$

The operator f_{op}, which operates on the arguments k and k', becomes a constant c-number (f) only if the two constants f and g, occurring in Kemmer's equations[5], would happen to be equal. As experiment seems to indicate[9] that these constants do not differ very much, this formal argument for the advantage of equality of f and g seems to be interesting.

The electric charge-density and electric current are given by[6]

$$\rho = (e/8\hbar)\ .\ \Psi^*(\beta + \beta')\Psi,$$

$$\vec{j} = (e/8\hbar)\ .\ \Psi^*(\beta\vec{\alpha}' + \beta'\vec{\alpha})\Psi.$$

The wave-function of *free* baryterons can be interpreted to some extent as the Dirac wave-function in the hole-theory of electrons. In both cases the same kinds of difficulty arise.

As for the complications occurring in baryteron theory[7,8], as well as in the quantum theory of the Maxwellian field[10,11], which are caused by the fact that some of the canonical equations of the field do not contain time derivatives, it is possible to develop a theory of quantization of mixed fields of Fermi-Dirac particles and Einstein-Bose quanta, in which the question of dealing with such complications is answered in a rather general way.

Details will be published elsewhere.

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* *Undα* = Wave.

* Βαρυτερος = heavier.

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Exploration of the Sun's Disk and its Astrophysical Results

IN NATURE recently (Dec. 10, p. 1035), I took the opportunity, in connexion with the recent researches on practical relativity by H. E. Ives and G. R. Stilwell, to place on record that on principles scarcely anywhere denied now, a radiating atom, or system of atoms, falling free into the sun or describing a free orbit close around it should not experience any internal influence on the periods of its radiation, the

relativist factor due to the velocity produced being exactly balanced by another scalar direct effect of the field of gravitation itself: so that there would be left in evidence only the inevitable kinematic (Doppler) effect arising from mutual approach of the radiator and the terrestrial observer which, however, would soon rise to preponderance with increasing velocity.

I had forgotten at the time an array of important evidence bearing on this subject, in which I took close interest a year or two ago. I had been permitted by Mr. J. Evershed to learn in advance the results of his exploration of the variations of radiation periods on the solar disk, as it proceeded with greatly improved methods in his underground spectroscopic observatory in the Surrey hills, in continuation of researches in India by which he established an international fame for the solar observatory at Kodaikanal, above Madras. As he has now published preliminary results, in the *Observatory*, I can make use of this personal knowledge. Briefly, it was concluded that the observations could be fairly represented by an effect of the general type of pure relativity, such as might be due to the gravitating field of the sun but of about twice the Einstein predicted amount, combined, however, with a vector (Doppler) effect such as would arise from a *slow radial fall* of the absorbing system of atoms into the sun, about equal at its maximum, which is at the centre of the disk, to the Einstein factor, and, of course, vanishing at the limb, thus strongly favouring the important and natural result that only the systems of cooler atoms falling back into the sun (here at about 2 km. per sec.) produce the Fraunhofer absorptions.

(The familiar Evershed drift at sunspots, of the same order as the above, is tangential inward above and outward below, adjusted perhaps to compensate a much greater radial fall into the spot of the cooler absorbing gases such as would be required to damp off the continuous radiation of the photosphere below.)

If the outer layer of radiating atoms were subject to free fall into the sun, there would thus in fact be vanishing effect on periods, in accord with the general relations of relativity for isolated systems, as recognized and known definitely in England and America now for forty years. It follows that the forces of mutual atomic collision which float up the radiating atoms in the sun's atmosphere must provide a compensating factor that annuls, largely at any rate, what would be the result of free fall; for otherwise the total result for undisturbed falling atoms could not be null, as perhaps nobody would appear now to deny.

Another important result is to be signalized here. Astronomers are now accustomed to believe, on this type of spectroscopic evidence, that the dark companion of the star Sirius has a density, of value perhaps bordering on the fantastic, being about eight thousand times that of iron—though indeed this only involves that the atoms are twenty times closer packed in linear order. If the gravitational spectroscopic displacement is not solely of the Einstein type and is moreover mixed up, as here indicated, with effects due to other restraints and forces, there appears to be ample room, amid new atomic discoveries and ideas, for reconsideration of this decision as to abnormal material densities in stars.

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Jan. 1.

Frequency Interpretation in Inverse Probability

DR. JEFFREYS implies in his letter in NATURE of September 17 (p. 535) that a prior probability cannot have a frequency interpretation. That there are several usages of the word probability is well recognized—it is a frequency, a mathematical result, a state of mind, or a degree of rational belief, depending on the circumstances. Jeffreys' point of view must be insisted on only when the conditions under which an experiment is performed are not subject to repeated sampling. However preponderant these circumstances may be in practice, it is important that consideration be given to problems in which the frequency interpretation does apply to the prior probabilities, since the frequency interpretation is the only one that is operationally verifiable.

A problem for illustration is this. A box has had 10 balls transferred to it by a blindfolded man from an auxiliary container holding equal numbers of black and white balls, the contents of the auxiliary container being kept constant and thoroughly mixed by an assistant. Then *an experiment* is carried out on the box; the blindfolded man draws a ball from the box and returns it, the assistant noting the colour of the ball and shaking the box before the next draw. The blindfolded man makes five such draws from the box (each with replacement); four of them show black and one white. What are the probabilities of the various possible contents of the box? (Reworded from an example given in Fry's "Probability", Van Nostrand, 1928, p. 123.)

The stirring and blindfolding, we shall presume, create randomness and cause the point binomial to be applicable in the frequency sense, both with regard to the 10 balls put into the box and the 'experiment' of drawing 5 balls with the replacement from the box. The equal numbers in the auxiliary container have only the effect of making $p = q = \frac{1}{2}$ in the binomial expansion of $(q + p)^n$, and any other proportions would do as well. We have at once from the binomial expansion the term $\binom{n}{r}q^{n-r}p^r$ for the prior probability that r white balls found their way into the box in the first place ($n = 10$; $r = 0, 1, 2 \ldots, 10$; $p = q = \frac{1}{2}$). Now *if* there are r white balls in the box, the probability that five draws, with replacement, will show 4 black and 1 white is $\binom{5}{1}\left(\frac{r}{10}\right)\left(\frac{10-r}{10}\right)^4$, whereupon the simultaneous probability that r of the 10 balls in the box are white, *and* that the 'experiment' should show 4 black and 1 white, is the product of these two expressions, namely,

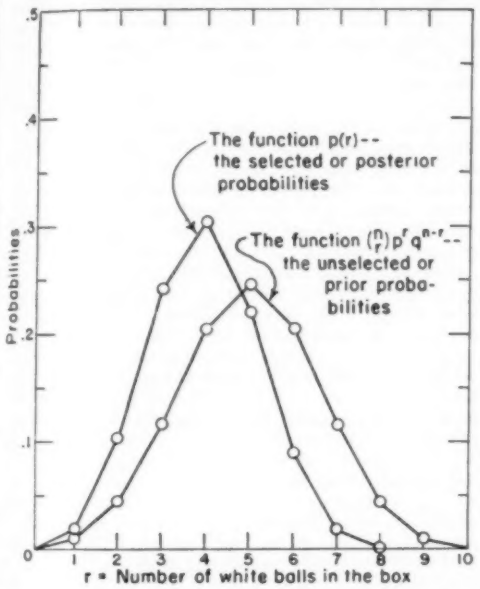
$$\binom{10}{r}\left(\tfrac{1}{2}\right)^{10-r}\left(\tfrac{1}{2}\right)^r\binom{5}{1}\left(\frac{r}{10}\right)\left(\frac{10-r}{10}\right)^4.$$

If we now 'normalize' this product we shall have, after cancelling common factors,

$$p(r) = \frac{\binom{10}{r}\left(\frac{r}{10}\right)\left(\frac{10-r}{10}\right)^4}{\sum_{r=0}^{10}\binom{10}{r}\left(\frac{r}{10}\right)\left(\frac{10-r}{10}\right)^4}$$

for the 'posterior probability' of there being r white balls in the box. Plotted against r, the two functions $\binom{n}{r}q^{n-r}p^r$ and $p(r)$ give the two sets of points shown in the accompanying figure (for clarity the points in each set have been joined by a broken line).

The frequency interpretation of the prior probability $\binom{n}{r} q^{n-r}p^r$ is as follows: at a single filling of the box there are either, for example, 3 white balls in the box or there are not; that is, the probability of there being 3 white balls in the box is either 0 or 1, no intermediate value being admitted. There is no talk of the probability of there being r white balls in the box, in the frequency sense, unless the box is filled *many times* from the auxiliary container under conditions that produce random results in the box content. If this is presumed, then after a large number of fillings, a record of the box content would show $\binom{n}{r} q^{n-r}p^r$ for the relative frequencies of r white balls getting into the box ($r = 0, 1, 2, 3 \ldots 10$); we can assert this because the drawings are 'at random',



which I take to mean nothing more nor less than the validity of the frequency interpretation of the binomial expansion. The term $\binom{n}{r} q^{n-r}p^r$ is ordinarily called the 'prior probability' of r white balls, but a better name might be *unselected* probability, and it is so labelled in the figure: it is unselected because *all fillings have been counted* in the record, that is, no selection from the record has been made.

Now for the frequency interpretation of $p(r)$, let us suppose that at each filling of the box, before it was emptied and filled again, the 'experiment' of drawing 5 balls was performed and the results noted. Then for each occasion upon which 10 balls were put into the box in the prescribed manner, we have a notation in our record showing, first, the number of white balls in the box (0, 1, 2 . . . 10), and secondly, the result of the experiment (0 white and 5 black, 1 white and 4 black . . . 5 white and 0 black); and there are supposedly some huge number of these notations. If we now strike from this record all the notations *except* those for which the immediate experiment yielded 4 black and 1 white, we shall find that the relative frequencies (probabilities) of r white balls in the box, *in this selected class*, is $p(r)$. The denominator of $p(r)$ is a mathematical device for accomplishing this selection. $P(r)$ is called the 'posterior probability' of r white balls in the box, but a better name would be the *selected* probability, and so it is labelled in the figure. Thus we see a frequency interpretation for both the prior and posterior probabilities, and we see also from the frequency point of view the distinction between them—in the former the probability of r white balls is computed without selection, and in the latter, with selection.

From the figure, it is evident that the box content that yields 4 black and 1 white most frequently in the 'experiments' is 6 black and 4 white. At the same time it is interesting to note that this particular box content will yield 3 black and 2 white in five draws more frequently than it will yield 4 black and 1 white, and that the optimum box content for 4 black and 1 white is 8 black and 2 white.

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An Electro-Chemical Theory of Salt Absorption and Respiration

THE surface layer of wheat roots which are put in distilled water behaves like a membrane charged with hydrogen ions in a concentration of about 10^{-3} N. (pH = *ca.* 3)[1]. If a neutral salt is added to the water, the metallic cations are adsorbed in exchange for part of the hydrogen ions. As a consequence, the actual pH of the protoplasmic membrane increases; in a 10^{-3} N. solution of potassium chloride it is about pH = 6. If the solution has pH = 7 a potential difference of about 58 mv. occurs. The protoplasmic membrane is then negative relatively to the solution. This negative charge is the normal state of the absorption cells of the root tissue.

Owing to the negative charge of the protoplasmic membrane, cations pass without difficulty into the protoplasm, whereas the uptake of anions requires energy supply. Oxidation processes seem to supply this energy.

Oxidation implies a decrease of the negative charge of the oxidized substance. According to Le Chatelier's principle, oxidation processes will be promoted in the surface of the protoplasm of root cells. Respiration is the oxidation of carbohydrates by free oxygen effected in special redox systems of the living cell. If such a respiration system is put into action by the potential difference between the protoplasmic membrane and the medium, it will act electrochemically as if electrons (anions) were thrown out into the solution. In exchange for these amounts of negative electricity that traverse the outer cell boundary, anions will move in the opposite direction from the medium into the cell.

This theory of 'anion respiration' is supported by a large number of observations made in my laboratory during the course of the last six years. A few of them are described here.

The respiration intensity of roots which are surrounded by distilled water always attains very high values[2]. Potential measurements[1] show a correspondingly high negative potential of the root surface. It attains values of − 150 to − 200 mv. In this case, the anion respiration will of course be 'idling', because there are no anions to absorb from the distilled water, except very small amounts of OH^- and HCO_3^-.

The relation $\frac{\text{respiration}}{\text{anion absorption}}$ shows high values when the salt concentration in the medium is low, and decreases with increasing concentration. The potential difference between the root and the medium decreases also with increasing salt concentration. In one series the relation $\frac{\text{K absorb.}}{\text{NO}_3 \text{ absorb.}}$ attained the values 0·77 in a 0·001 *N*. KNO_3 solution and 0·43 in a 0·01 *N*. solution. The initial potential difference was *ca.* − 70 mv. in the diluted and *ca.* − 25 mv. in the more concentrated solution. More energy is needed to absorb anions in the former case.

Extensive experiments[3] indicate a sort of quantitative relation between the amount of anions absorbed by the root and the respiration intensity during the same period. The following equation was formulated:

$$R_t = R_g + k.A,$$

where R_g is a fundamental or 'minimum' respiration that occurs independently of the mechanism of anion absorption; $k.A$ is the anion respiration, which is a multiple k of the anion absorption A; R_t is the total respiration measured in the experiments. The existence of a 'fundamental respiration' is proved by the fact that its intensity is unaffected by agents, for example, potassium cyanide, which check the anion absorption. The anion respiration is an oxidation mechanism which is regulated by the negative electrical charge of the protoplasmic membrane and it supplies apparently the energy for the absorption of anions against the potential gradient.

The above equation represents only the outlines of the process, for other factors also influence the surface potential of the protoplasm. Thus the coefficient k is a constant only if other factors, for example, the kind of cations in the solution, are constant too. From what has been said about salts and surface potential of the protoplasm, it is evident that the exchange power of the cations partly determines this potential. Bivalent ions have a larger exchange power than monovalent ones, and therefore, in equimolar concentration, depress the potential difference more. On the other hand, ions of high exchange power are less mobile in the protoplasmatic colloids; their retention in the solution increases again the negative potential in the protoplasmic membrane. It requires more energy, of course, to absorb anions from a solution if cations are held back than if they are absorbed in similar amounts too. Consequently absorption experiments show that the relation $\frac{\text{anion respiration}}{\text{anion absorption}} = k$ gives higher values for salts of bivalent cations, for example, Ca^{++}, than for potassium salts. For the same reason, k is higher in a barium salt than in a calcium salt (Ba^{++} is less mobile than Ca^{++}).

If the mechanism of the anion respiration is regulated by the negative charge in the protoplasmic membrane, and if this charge, as measurements show, is a product of the relation $\frac{\text{cH of protoplasmic membrane}}{\text{cH of the medium}}$, the cH value of the medium and all factors which determine this will be included in the complex of conditions which determine the value of the coefficient k in the above equation. Apart from the relative absorption velocity of cations and anions just mentioned, one end-product of the respiration, HCO_3-ions, is an important regulator of the *p*H of the medium. The aeration of the medium will consequently be an important factor, apart from the fact that the oxygen supply which controls the respiration also depends upon the aeration. The somewhat curious situation will then occur that a very effective aeration is a drawback for intensive anion uptake, because the carbon dioxide left in the solution helps the protoplasm to overcome the resistance to anion absorption.

The theory of anion respiration of which we have here given an outline refers to cells with a pronouncedly acid protoplasmic membrane. Such a membrane seems to be characteristic of plant roots. Other kinds of cells might behave differently. I recall in this connexion the interesting observations on the skin of frogs[4]. If the charge of the root cells is changed to positive by holding them in a *ca.* $10^{-2.5}$ *N*. solution of a strong acid, they die within a few minutes. Also in very concentrated salt solutions ($> 10^{-1}$ *N*. KCl) the charge of the membrane will be changed into positive; but the cells then live longer. Such media are by no means normal. On the other hand, one can easily conceive that cells of a normally positive charge relatively to the medium might exist. Such cells will be able to absorb anions without any extra energy supply, but the absorption of cations needs energy supply. This is a speculation so far, because our experience of the interference of reduction processes in ion absorption is very limited. From the point of view of electro-chemistry, reduction processes diminish the positive charge. Attention is here directed to the interesting results of Arens in the polarity of leaf cells during photosynthesis[5]. Potential gradients in protoplasmic boundaries are probably of fundamental importance both in the metabolism and in the translocation of substances within the organism, as well as in the absorption and excretion of ions. From this point of view the investigations in the ion absorption of plant roots may have a wider application.

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Reduction of Carbon Dioxide with Molecular Hydrogen in Green Algæ

A VIGOROUSLY growing pure culture of the alga *Scenedesmus* sp. D.3 is suspended in a hundredth molar (1/100 *M*.) solution of potassium bicarbonate and kept for six hours in the dark in an atmosphere of hydrogen containing 2 per cent carbon dioxide. Shortly before the last traces of oxygen in the vessel have disappeared by way of respiration, the cells begin to absorb hydrogen. The amount of hydrogen absorbed in this reaction varies with the condition of the algæ. After this absorption has stopped, practically no further gas exchange is observed. If the light is now turned on, no evolution of oxygen can be detected but the algæ begin to absorb hydrogen instead. The process has a measurable induction period, but thereafter it proceeds at a steady rate. This phenomenon is strikingly similar to the reduction of carbon dioxide with molecular hydrogen brought about by purple bacteria. That this absorption of hydrogen by the green algæ is connected with the

reduction of carbon dioxide can be shown by the same method which enables one to establish the ratio H_2/CO_2 in purple bacteria[1]. The algæ are suspended in a slightly acid phosphate buffer, treated with hydrogen in the dark, and then illuminated until all carbon dioxide stored or produced by fermentation has been used up in photosynthesis. Addition of a known amount of carbonate at this point is followed by a rapid uptake of hydrogen, the quantity of which exceeds the ratio $2H_2$ for $1CO_2$ found in purple bacteria. In *Scenedesmus* this ratio often reaches a value of about 3.

The reaction between molecular hydrogen and carbonic acid in green plants is affected in a peculiar manner by the light intensity. Up to a certain threshold the rate of hydrogen absorption is proportional to the light intensity and at constant intensity, when both reactants are present in excess, the reaction proceeds at a constant rate. If, however, the light exceeds a certain limit of intensity, the absorption of hydrogen stops and after a few minutes normal photosynthesis is in full activity with the production of oxygen.

This effect of light of too high intensity cannot be reversed merely by subsequent reduction of that intensity; a slow dark reaction is necessary to re-establish the bacterial type of light metabolism in green plants.

In the absence of light, 'hydrogen-treated' algæ are able to catalyse the 'oxyhydrogen' reaction, provided the tension of oxygen is held below a certain limiting value. Oxygen at a higher pressure inhibits the oxidation of hydrogen completely; once it has been inhibited, the reaction cannot be immediately restored by lowering the oxygen pressure. For reactivation an incubation period under anærobic conditions is necessary. The inhibiting effect of oxygen on the 'oxyhydrogen' reaction in *Scenedesmus* is very similar to the phenomenon in *Acetobacter peroxidans*[2].

These two observations in *Scenedesmus* supplement each other inasmuch as the reduction of carbon dioxide with hydrogen can be explained by the oxyhydrogen reaction, the catalytic system of the latter reaction being apparently able to use the molecular oxygen produced in photosynthesis at low light intensities. The reaction rates, however, suggest an alternative explanation. Under the conditions of the experiments the oxyhydrogen reaction in green plants may be catalysed by the same enzyme system which normally liberates oxygen in photosynthesis. When completely reduced, the enzyme would not react as a catalase but as an oxidase and a peroxidase. This action of the catalyst would be practically the same in green plants and in purple bacteria. The alternative explanation therefore brings photosynthesis by purple bacteria into accord with that in green plants. Added support to this hypothesis is found in the papers of Keilin and Hartree[3] and of Stern[4] on hydrogen peroxide catalase, from which it appears that catalase will occasionally act as a peroxidase.

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Hopkins Marine Station,
Pacific Grove, California. Nov. 9.

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Further Evidence for the Lamarckian Theory of the Cause of Evolution

THE death of Prof. William McDougall marks the end of an epoch in the history of biology. Prof. McDougall attained world-wide fame as a brilliant experimental psychologist, but his equally important work on the heritability of acquired habit has been, I think, for the most part overlooked. He experimented on rats, and he showed that when rats were forced by unpleasant experience to acquire a habit, they produced offspring which acquired the habit more readily than did their parents until, at the end of nine years, they acquired the habit at the first contact with the unpleasant experience.

The late Miss Dorothy Sladden (whose work has periodically been noted in NATURE) also, like McDougall, was engaged in experiments on the heritability of acquired habit, though she knew nothing of McDougall's work. When she died her work, like that of McDougall, was complete, but the final and conclusive part of it was embodied in jottings in note-books and columns of figures. My former colleague, Mr. H. M. Hewer, has edited these notes and published his results, which were noted in NATURE[1].

As Miss Sladden's experiments were of a much simpler type than those of McDougall, a very brief account of them may be given here. She used the stick-insect *Carausius morosus*, a native of South India, which in Great Britain normally feeds on privet. This insect was subjected to periods of semi-starvation, each lasting two days, when it was offered ivy for food which it detested. At the end of each period it was revived by a leaf of privet. Each of these ordeals was called a 'presentation'. The overwhelming majority of the insects would not accept ivy until the fifth presentation, and some even held out until the tenth presentation. These insects are parthenogenetic and when their eggs were collected and bred from, it was found that they accepted ivy at an earlier presentation than did their parents until at the end of five years they took ivy at the first opportunity. Thus Miss Sladden and Prof. McDougall between them have adduced evidence in support of the hypothesis that the acquired habits of one generation are passed on to the next.

Of this I may give two examples. The Didsbury Institute informs me that the effort to transplant sea-island cotton from islets off the coast of Carolina to other parts of the world has resulted in failure. In a few years the transported cotton reverts to the native stock. On the other hand, Marquis wheat, which has doubled the Canadian wheat crop owing to its ability to survive 'summer frosts', has been proved to be a northern Russian race which has gradually adapted itself to the rigours of a subarctic climate. 'Mutants' only persist when cultivated under the exact conditions of soil in which they made their appearance; further, they become progressively weaker and liable to disease.

The alternative hypothesis as to the origin of species has been that these originated from the sports familiar to us in the garden and farmyard which are the source of some of our most valuable domesticated animals and plants. But there are two difficulties about this hypothesis: first, Mohr, whom the late Dr. Bateson called the first geneticist in Europe, has shown that all sports are physiologically weaklings and could never survive in the open; and secondly, that when such sports are returned to the wild in a

place where their natural enemies are absent, in forty-fifty years they revert to the condition of the wild ancestor. Further, though it might be supposed that the study of these sports is of prime importance to the farmer, experience shows that this is not so. Thus the work of these two experimenters has raised Lamarckism from the rank of an hypothesis to the status of a proved fact; for the first time evolution has been experimentally demonstrated in the laboratory.

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NATURE, 142, 801 (1938).

The Dead Language of Science

PROF. F. E. FRITSCH[1] complains of the many new terms encumbering a recent German text. We must all sympathize with his view. But is there not a worse evil in our midst, one to which long use has inured us? I mean the constant reiteration of dead terms, of decayed verbiage. Prof. Fritsch disinters a sample, the word 'spireme', and discusses its use. This word originally (in 1882, according to Wilson) referred to the threads seen in the prophase of a nuclear division, mitosis or meiosis. In England and America it was connected with *Œnothera* in 1907, and became known as the 'continuous spireme' of meiosis. This connexion ended after a period of some confusion in 1932, when the spireme suddenly passed away. By 1934 it had disappeared from Sharp's "Introduction to Cytology". It is no doubt from the *Œnothera* connexion that Prof. Fritsch recollects the word and in a meaning to which it was never restricted elsewhere. In Germany its last technical use is found in 1934 (Geitler, "Grundriss der Cytologie"). There also it has since disappeared (Geitler, 1938, "Chromosomenbau").

By technical use, I mean use by those who are handling the material or studying the process every day. There are many words, dead words, found in text-books for elementary students which are never used in technical practice. This fact is obvious as soon as it is pointed out. Take the word 'karyokinesis'. It is never used either in speech or writing by those who study nuclear division, and was effectively superseded by 'mitosis' more than fifty years ago. Yet almost every English text-book mentioning cytology tells its readers that nuclear division is known as karyokinesis or mitosis; and every student commits to memory this unnecessary fiction—usually, it must be admitted, along with a correspondingly erroneous account of the process. Other sciences could tell the same tale.

There are many words in text-book currency which fall into this phlogiston group. Words like 'heterotypic mitosis', 'nuclear reticulum', 'telosynapsis' and 'xenia' are the dead or dying remains of past misunderstandings—merely useless lumber. There are many others not yet dead, however, which have no proper place in text-books. Words as cacophonous as 'obdiplostemony', as obscure as 'arrhenotoky', as superfluous as 'phragmoplast' must give the specialist pause.

It is to be feared that men of science in all countries will often, in inventing new terms, create hideous, meaningless and unnecessary words. It is also to be feared that compilers of text-books will often be afraid of appearing ignorant if they neglect to record these verbal discoveries. But it is the business of these writers to sort out the words which will convey the information necessary for doing certain work. Words that do not fulfil this use should always be rejected from the text and segregated in a glossary for the inspection of the learned, not for the confusion of the learner.

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[1] NATURE, 143, 47 (1939).

The Prehensile Paw of the Giant Panda

IN NATURE of January 28, p. 157, Prof. Wood-Jones, in his description of the prehensile digit in the fore paw of the giant panda, stated that the radial sesamoid bone has a special muscular arrangement making it movable so as to act as a true thumb; it "usurps the place of the true thumb and simulates all its movements".

This remark must have been based, I think, upon an examination of the paw with the skin removed, because in the skeleton of the foot, as has been known for years, the lengthened sesamoid bone in question looks, in a measure, so like an additional digit on the inner side of the foot that anyone might be excused for suspecting that it projects like a thumb and is capable of considerable lateral movement, giving it a prehensile function. It has scarcely any such function. It is enveloped in the skin of the foot, like the metacarpal bones, and is quite invisible, the only indication of it, as is also well known, being the enlarged, cushion-like extension of the plantar pad which covers its apex. The use of this pad was unsuspected until the living animals were observed in the Zoological Gardens. On the dead specimen, I found it capable of only slight movement; but it acts as an accessory to the prehensile power of the first and, to a lesser degree, of the second digit. When these are normally flexed in a vertical plane, their terminal pads come into contact with this elevated portion of the plantar pad and constitute a grasping organ. The mechanism is exactly comparable to that produced by bringing the tips of the first and second fingers on to the ball of the thumb in the human hand.

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Turtles in the English Channel

IN his interesting letter on the occurrence of turtles in British waters, Mr. H. W. Parker[1] has suggested that their presence in the English Channel may be an indication of the drift of warm surface water up-Channel. There is another possible explanation. Evidence has not been lacking during recent years that there has been an extension of the distribution of many warm water animals to the far north (see, for example, Stephen[2]). Recently also the unusual capture of a flying fish, *Cypsilurus heterurus*, in Oslo Harbour in 1937 has been recorded by A. Wollebaek (see Bruun[3]); this is the first record of a flying fish at Oslo since 1848.

While there is no indication that the water temperature in the Channel region is any higher than normal, there can be no doubt that warm water has been penetrating farther towards Arctic regions. This will

allow an extension of the northern boundary of certain animals, and it is perhaps natural to suppose that, following this extension, the centres of distribution may also have shifted more to the north. Such an extension might thus bring turtles into a region in which westerly winds would tend to drift them up the English Channel, without necessarily a passage of any considerable body of water in the same direction.

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Jan. 21.

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Formation of Native Lead under Laboratory Conditions

THE conditions which may have governed the formation of native metals in non-igneous rocks are not always readily reproducible in the laboratory owing to the difficulty of performing experiments requiring many years for completion. An observation made during the reconstruction of the Plymouth Laboratory may be regarded as an experiment of fifty years duration.

The slate back, sides and bottom of the aquarium tanks in the main laboratory, built in 1888 and dismantled recently, were cemented with a lute composed of white lead with some red lead and linseed oil. During fifty years, pockets and seepage channels have formed into which sea-water, rich in organic matter, has crept. The oxides and carbonates of lead have been reduced, in some places to black lead sulphide. More remarkable has been the further reduction, in other pockets, giving rise to inclusions of metallic lead answering to the usual analytical tests. When first exposed these had rough but bright metallic surfaces, similar in appearance, both to the unaided eye and under the microscope, to commercial lead which had been etched with dilute acetic acid.

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Jan. 10.

Points from Foregoing Letters

INFRA-RED absorption in the region of 3 μ of *o*- and *p*-methoxybenzoic acids in carbon tetrachloride has been investigated by Dr. J. J. Fox and Dr. A. E. Martin. These compounds show a small band attributable to OH vibrations in the monomer, and a broad band at 3·4 μ due to OH vibrations in the dimer. In addition, the *ortho*-compound has an intense band at 2·974 μ ascribed to intramolecular association of the OH group.

Prof. H. A. Bethe, F. Hoyle and Prof. R. Peierls state that the experimental evidence on β-disintegrations, except for the shape of the energy spectrum, supports Fermi's original theory rather than its modification by Konopinski and Uhlenbeck, and that one can account for the shape of the spectrum by postulating the emission, in some disintegrations, of γ-rays of suitable energy and intensity. The existence of such γ-rays is in some cases confirmed, in others not ruled out, by the experimental evidence.

In the same way as vectors are generalized to tensors, Dirac wave-functions may be generalized to 'undors' and a consistent undor-calculus may be developed, according to F. J. Belinfante, who presents the equation for heavy quanta (baryterons) in a concise form closely analogous to the Dirac equation of the electron.

Referring to the variations observed by J. Evershed in the radiation periods on the solar disk, Sir Joseph Larmor states that they support the view that the forces of mutual atomic collision which float up the radiating atoms in the sun's atmosphere must provide a compensating factor that annuls any influence on the period of radiation which would otherwise be produced by the free fall. If the gravitational spectroscopic displacement is not solely of the Einsteinian type but is influenced by other forces, as indicated, it may be necessary to reconsider the enormous densities which have been calculated for certain stars such as the dark companion of Sirius.

Dr. W. Edwards Deming takes the view that there are circumstances in which prior probabilities have a frequency interpretation, and describes an experiment in which the frequency interpretations of the prior and posterior probabilities are contrasted: the former, he states, are probabilities associated with the circumstances in which all the experiments are performed, and might be termed *unselected*. The posterior probabilities also refer to the circumstances of the experiment but not to all experiments; they refer to the selected class, namely, those that had a particular result, all others being excluded, and might be designated as *selected* rather than posterior.

Prof. H. Lundegårdh develops an electrochemical theory of salt absorption according to which cations pass without difficulty into the protoplasm owing to the negative charge of the protoplasmic plant membrane, whereas the uptake of anions requires a supply of energy, which is provided by oxidation processes. The author remarks that this applies to the plant cells so far investigated and that other cells may behave differently.

Dr. H. Gaffron states that by prolonged anærobic treatment in an atmosphere of hydrogen green algæ acquire the capacity to reduce carbon dioxide with hydrogen when illuminated. No oxygen is developed. This new light reaction may go on for a long time at low light intensities but stops immediately at higher intensities, the absorption of hydrogen then changing into the normal production of oxygen.

The work of Prof. W. McDougall and Miss Dorothy Sladden is quoted by Prof. E. W. MacBride as affording conclusive evidence that acquired habits of one generation may be passed on to the next. Prof. MacBride reiterates his view that this is the main mechanism of evolutionary change, and maintains that 'mutants' are physiologically weaklings which tend to return to the ancestral type.

Research Items

Archæological Excavations at Eastburn, Yorkshire

IN the making of a new aerodrome at Eastburn on the Yorkshire Wolds, near Driffield, skeletons were found which on examination proved to be of iron age type; but no pottery or metal was found with them to determine their age. Later, in the course of constructing a hangar, some fifty iron age graves were exposed. The site and the relics recovered have been described by Mr. Thomas Sheppard (*Hull Museum Publications*, **197**; 1938). Each tumulus was very clearly indicated in the white chalk gravel by a circle representing a slight trench on the outside of the mound, and a dark, usually squarish, place in the centre of the circle, three to four feet across, which contained a skeleton or occasionally two skeletons. The bones were so decomposed that in three instances only was it possible to remove sufficient of the skull for examination. No pottery or iron was associated with the burials, excepting a single iron brooch or fibula of the involuted type. This type is considered by Sir Arthur Evans to date from 300 B.C. A fragment of a similar brooch was brought to the excavator. It had a knob of red glass still attached by a metal stem, of which the head is apparently copper. A typical iron age pot larger than those from the Danes graves was also found. A year later further discoveries were made, including a female skeleton in remarkably good condition. Three earthenware vessels were also found, of which one, a small vessel with a slightly curved depression between lip and shoulder, is the only one of its kind found in that condition in East Yorkshire. The largest of the three is an example of coiled technique. This vessel and another each contained the humerus of a pig. Among the iron objects found were a leaf-shaped spearhead and a remarkable iron sword 28 inches in length. Its handle had been mounted with horn and there were traces of a wooden scabbard. On the arm of a female skeleton was a bronze bracelet of great beauty with two decorated bands of cable-like design. Roman and Anglo-Saxon relics also occurred on the site.

Recent Research on Cancer

THE thirty-sixth annual report of the Imperial Cancer Research Fund, which has just been published, is the first to appear since the Fund moved into new laboratories at Mill Hill. It summarizes the work carried out during the last year on carcinogenesis, the nature of tumour viruses, the action of radiations and of hormones and the properties of tissue cultures. Dr. F. R. Selbie and Dr. C. Foulds have extended knowledge on the carcinogenic action of radioactive substances. They obtained tumours at the site of injection with thorotrast (a colloidal preparation of thorium oxide) in rats, mice and guinea pigs. There would seem to be little doubt that thorotrast should not be used clinically on account of its possible carcinogenic action on man. Dr. W. Cramer and Dr. E. S. Horning investigated the antagonism between œstrone and the hormones of the pituitary acidophil cells. In a preliminary experiment they have been able to inhibit the spontaneous incidence of mammary cancer in mice by treatment with preparations of the pituitary thyrotropic hormone. If fibroblasts and sarcoma cells are grown as tissue cultures in plasma, the sarcoma cells liquefy the clot more rapidly than do the non-malignant cells. Dr. R. J. Ludford has found that some trypanocidal agents such as Trypan Blue and Bayer 205 promote this liquefaction of the clot by cells, but this action is not specifically associated with tumour cells. Mr. H. G. Crabtree, in conjunction with Dr. L. H. Gray of the Mount Vernon Hospital, found that the ability of isolated tumour tissue and isolated retina to produce lactic acid are both equally inhibited by equivalent doses of γ-radiation, β-radiation or X-radiation when applied *in vitro* at low temperature.

Tubercular Allergy without Infection

F. R. Sabin and A. L. Joyner (*J. Exp. Med.*, **68**, 659; 1938) found that guinea pigs could be rendered hypersensitive to tuberculo-protein by small, repeated, intradermal injections of active tuberculo-protein. The process of sensitization could be accelerated by the addition of tuberculo-phosphatide to the protein, so that the reactions became indurated and necrotic and closely simulated tuberculous disease. Injection of active tuberculo-protein induced a new formation of monocytes and some epithelioid cells, and the addition of phosphatide to the protein brought about a massive formation of epithelioid cells. The writers regard the intradermal route as the best for these sensitizations probably because it provided the largest dose per cell of the sensitizing agent. They compare the degree of sensitization artificially obtainable by the synergic action of tuberculo-phosphatide and tuberculo-protein to the degree of sensitization naturally occurring in tuberculous animals.

Reactions of House-flies to Light of Different Wave-lengths

J. W. MACBAIN CAMERON, of Macdonald College, Montreal, has recently described experiments which were conducted with the object of testing the reactions of house-flies to different wave-lengths of light (*Canadian J. Res.*, **16**, 307; 1938). The insects were reared on an artificial medium and tested by means of different wave-lengths of spectral light obtained from a quartz-mercury vapour lamp. The range of the spectrum tested was from 3022 A. to 5780 A. and the lines were made of approximately equal intensity throughout. In addition, 5461 A. and 4078 A. were tested at several other intensities. The comparison standard, which was used in all cases, was white light obtained from a tungsten filament frosted bulb. Flies to be tested were removed from breeding cages ten hours before the tests began and were kept in darkness until used. It was found that the house-fly is much more strongly stimulated by ultra-violet light of wave-length 3656 A. than by any other part of the spectrum tested. The influence decreases as the longer wave-lengths are reached and also on the short wave-length side of the peak. The available spectrum extended as far as 3022 A. into the ultra-violet, and at this point there is still an attractiveness greater than that exercised either by yellow or green.

Original Home of the Coco-nut

UNDER this title P. V. Mayuranathan, curator of the Botany Department, Government Museum, Madras, has published an interesting discussion of this subject (*J. Bombay Nat. Hist. Soc.*, **11**, (2); September 1938). His paper examines particularly the question of the antiquity of the coco-nut in India, and whilst discussing previous suggestions as to the original home and the subsequent course of distribution of this palm, it pays particular attention to the geological history of the regions under discussion and supplements botanical evidence with that drawn from philological and ethnological sources. So old is the coco-nut in India that the Arabs from early times called it the Indian nut. On the other hand, *Cocos* is an American genus with no other living representative of that genus anywhere except in the continent of America. The author's solution is that it originated in that ancient Papuan land which included the island continent of New Guinea as we know it to-day; from there the strong eastward current during the north-east monsoon carried it through the Straits of Malacca into the Bay of Bengal, and primitive man brought it over to the shores of India. The discovery of fossil *Cocos* in the Pliocene deposits of New Zealand would be in accord with this view.

Northern Californian Earthquakes during 1937

As is well known, California forms part of that well-established ring of instability, the circum-Pacific circle, and it was in the Californian region that on April 18, 1906, occurred the great earthquake which wrought havoc in San Francisco and caused such remarkable displacements along the San Andreas rift. During 1937 there was no shock so great as this one, but there were approximately 277 earth quakes and earth tremors of varying intensity. Their intensities and distribution have been examined by Perry Byerly and John N. Adkins (*Bull. Seis. Soc. Amer.*, **28**, No. 4, 263–268; Oct. 1938). One hundred and forty earthquakes were sufficiently well recorded at the various stations for their seventy-five epicentres and initial times to be determined, and for these a map has been drawn by the authors. The epicentres form a broad band parallel with the coast-line with, as in 1936, a region comparatively free from epicentres between Humboldt County and San Francisco Bay, a very active region east of Monterey Bay, and very few epicentres along the San Andreas Fault between Monterey Bay and San Francisco. Compared with 1936 there was increased activity in the region east of San Francisco Bay. There appears to have been also a line of epicentres roughly at right angles to the coast, approximately through the towns of Greenfield and Merced. Seventeen earthquakes occurred in known regions the epicentres of which could not be located accurately owing to poverty of data, and the following observatories recorded shocks not felt by persons or recorded at other observatories: Berkeley, 26; Mount Hamilton, 28; Palo Alto, 38; San Francisco, 2; Ferndale, 8; Fresno, 3. Finally, fifteen shocks were recorded at more than one station, not felt by people and insufficiently well recorded for their epicentres to be located.

Analysis of Mine Dusts

PAPER No. 101, on the analysis of mine dusts, by A. L. Godbert, Safety in Mines Research Board (H.M. Stationery Office, London, S.W.1, 1938. 1*s.* 6*d.*) gives an alternative method of determining the carbon dioxide contents of mine dusts containing carbonates and a method of determining separately the free and combined water in mine dusts containing gypsum. These data are important in relation to the suppressing action on inflammation of coal dusts known to result from carbonates and combined water.

Density Condensation of Cepheid Variables

ZDENĚK KOPAL has recently published the results of his research on 88 δ Cephei stars and 30 variables of the RR Lyræ type (*Mon. Not. Roy. Astro. Soc.*, **99**, 1; Nov. 1938). He makes use of the well-known period-luminosity and mass-luminosity relations and also assumes that the cepheids radiate like black bodies, from which two tables are compiled showing the following results: P, the period of pulsation; Sp, the spectral type; $\log T_*/T_\odot$, $T_\odot$ and T_*, referring to the temperatures of the sun and star respectively; absolute visual and also absolute bolometric magnitudes; $\log \sqrt{\rho m}$; $\log P\sqrt{\rho m}$, ρ being the density. Although it has been assumed for a considerable time that P has nearly the same value for all cepheids, it is shown in the tables that there is practically no foundation for this assumption. There is a well-defined relation between $P\sqrt{\rho m}$ and the spectrum, and it seems that there is a close connexion between the density condensations of cepheids and their spectral class. This, of course, depends on the hypotheses involved in the present state of the pulsating theory being correct. There is a gap in the values $P\sqrt{\rho m}$ between the long- and short-period cepheids at spectral type F 5, and it is suggested that the sudden change of $P\sqrt{\rho}$ takes place when a certain temperature has been reached so that there is an alteration in the ratio of specific heats. This explanation, however, is ruled out, and a real change of density condensation is believed to take place. This affords good reasons for the assumption that the long- and short-period cepheids are of essentially different structure.

A Comparison Sequence for Nova Lacertæ

S. A. Mitchell and C. A. Wirtanen have published a paper with this title which will prove useful to variable star observers (*Mon. Not. Roy. Astro. Soc.*, **99**, 1; Nov. 1938). The paper is the outcome of an informal meeting of the leaders of the American, British and French variable star associations during the sessions of the I.A.U. held at Stockholm last year. A request was made that the Leander McCormick Observatory should publish the magnitudes and co-ordinates of sequence stars for long-period variables that have been determined since *McCormick Publications*, **6**, appeared in 1935, and a special request was made for Nova Lacertæ, No. 2. A table gives visual and photo-visual magnitudes for thirty stars with their co-ordinates, and, assuming equal accuracy for each method, the probable error of one magnitude is 0·02 magnitude. Three of the faintest stars of the sequence, magnitudes 14·6, 15·0, 15·3, have no photovisual magnitudes and these have been observed independently by W. H. Steavenson. Mitchell, using the 26-in. refractor, made visual sequences of grade estimates, and it will be shown in the forthcoming variable-star publication that the scale of his visual magnitudes agrees very closely with the international photovisual system to which the values of Nova Lacertæ are reduced.

Science and Philosophy

IN a Friday evening discourse delivered at the Royal Institution on December 2, the Right Hon. Viscount Samuel discussed the importance of obtaining closer co-operation between science and philosophy than there has been in the past. The scientific worker, intent on special problems, has tended to ignore the need to examine the general principles on which his studies rest. Separation has come from the other side too. Nineteenth century philosophy of the idealist tradition went on its way regardless of science, with disastrous consequences. The question is not a purely academic one. At the present time, he said, "every land resounds with the tramp of armies, and the air throbs with the droning of their aircraft. Behind the armies are the dictators or the parliaments. Behind them are the political creeds—Communism, National-Socialism, Fascism, Democracy. And behind the creeds are the philosophers—Marx and Engels; Hegel, Nietzsche, Spengler, Sorel and Croce; Mill and the other protagonists of liberty. Some of the creeds, it is true, are anti-intellectual; but irrationalism also is a philosophy of a kind".

If philosophies of this kind are to be avoided, a reasonable basis must be found for ethics and religion in place of the confusion and uncertainty now prevailing. The first step in this direction is for the philosopher frankly to accept the main conclusions and point of view of science. In particular, he must admit that the universe exists independently of human thought. Men and their thoughts enjoy no special privilege except as parts and products of this universe. The realist tendencies that are noticeable in recent philosophy in Great Britain and in the United States are therefore to be welcomed. As a consequence of such a realist attitude some old metaphysical difficulties about space and time, and about substance and qualities, should disappear. Lastly, it is necessary to abandon the notion that what we call 'values'—truth, beauty and goodness—are ingredients of the world at large. As Alexander has said, "Values are human inventions". This means that, in the sphere of ethics, actions are to be judged by their consequences, not in terms of any supposed *a priori* moral principles.

These are examples where the philosopher should look to the man of science for guidance; but there are others where the philosopher should be able to help the man of science. For one thing, he can urge the need of caution in accepting the paradoxes that have been prominent in recent scientific thought. An example of this is the tendency to attribute physical properties to space. Strictly, space indicates only an interval between things or processes. If it is really empty, it cannot have physical properties. If any such properties have to be attributed, it should be openly acknowledged not to be empty, as was admitted by the old 'ether' hypothesis. Another example is the tendency to make Heisenberg's Uncertainty Principle an argument for abandoning the notion of causality, on which scientific procedure is based.

The philosopher may also be of use in directing attention to unfilled gaps in scientific theory. One of these is the absence of any explanation of gravitation. In spite of the Theory of Relativity, gravitation is still, as it was in Newton's day, a 'brute fact' unconnected with anything else known about matter. Conceivably the internal structure of the atom may provide the answer. Another, and perhaps a more scandalous, gap in theory is that the great problem of the relation of mind and body remains apparently untouched. Although science itself is a process of thought, science tells us nothing about the nature of thought. A serious mistake has perhaps been made in supposing that perception is necessarily confined to the known functions of the human sense organs. The solution of the problem may possibly come from the science of electro-physiology, which is still only in its infancy.

There are already encouraging signs, Lord Samuel concluded, that science and philosophy are coming closer together. If this union becomes complete, and if the long-standing isolation of religion can also be overcome, it may be possible at last for mankind to possess a unified and harmonious basis for thought and action.

The Expanding Universe

A DISCUSSION on the subject of the Expanding Universe was held on January 27 under the joint auspices of the Physical Society and the Royal Astronomical Society, the chair being taken by the Astronomer Royal. The discussion was opened by Prof. G. Temple and Dr. G. C. McVittie in two papers which gave general surveys of the theory of relativistic cosmology and of the information to be derived from astronomical observations.

The first of these papers dealt especially with the developments in relativistic theories of the large-scale structure of the universe since the publication of Robertson's report in 1933[1]. The more important of these developments are the investigations of Milne and his school into the possibility of solving the cosmological problem by the methods of the special theory of relativity, and the researches of Whittaker and his fellow-workers on the form taken by the astronomical distance functions in general relativity.

A cosmological theory which endeavours to explore world structure by means of terrestrial observations is necessarily speculative, and the relativistic theories rest upon two main hypotheses—the uniformity of space-time and the homogeneity of the nebular distribution. The first of these leads to either the special or the general theory of relativity, according as the uniformity is taken to be 'global' or 'local'. The second hypothesis, first formulated satisfactorily

by Milne, then shows that the space-time is stratified in such a way that the line element may be written in the form

$$ds^2 = dt^2 - c^2 e^{g(t)}\{(1 - kr^2/R_0^2)dr^2 + r^2 d\theta^2 + r^2 \sin^2\theta d\varphi^2\},$$

where the world-lines of nebulæ (r, θ, φ = constants) are orthogonal to the hyper-surfaces of stratification S, t = constant. The general theory provides an expression for $g(t)$ in terms of the cosmological constant λ, the curvature constant k of the hyper-surfaces S (which may be $+1$, 0, or -1,) the radius R_0 of S, and the number α of nebulæ per unit volume on some specified S. Prof. Temple concluded by directing attention to the fact that the system of real co-ordinates (t, r, θ, φ) covers only that region of space-time actually traversed by the nebulæ, and he indicated the possibility that an empty region of space time might exist outside the system of expanding nebulæ—as it actually does in Milne's theory.

Dr. McVittie then gave a critical account of the construction of the semi-empirical equations summarizing the observed relations between the red-shift δ, the apparent photographic magnitude m and the number N_m of nebulæ with magnitudes less than m. He pointed out that Hubble's equations depend upon a number of *ad hoc* assumptions which are entirely arbitrary in character and unsupported by the general relativistic theory. In these circumstances, the obvious course is to utilize the relations between observable quantities furnished by the general theory. These alone, however, are insufficient and an additional datum is required, which McVittie finds in the estimate of the average mass of the visible nebulæ, $M_0 = 4 \times 10^{44}$ gm. His analysis of the observations leads to the surprising conclusion that $k = -1$, so that the hyper-surfaces S are 'hyperbolic' in character, the radius R_0 lying between 10^8 and 10^9 parsecs. The average density is probably of the order of 10^{-29} gm. cm.$^{-3}$ and the effective temperature of the nebular radiation lies between 5,000° and 7,500°. The cosmical constant λ is expressed by the difference of two numbers of the same order of magnitude, and, owing to the considerable uncertainty in their values, no reliable information is forthcoming concerning the value of λ.

In the subsequent discussion, an important point was raised by Sir James Jeans, who inquired if the sign of k is sensitive to changes in the estimation of the average nebular mass M. In reply, Dr. McVittie stated that the conclusion $k = -1$ would probably persist even if his estimated value of M_0 were increased by a factor of about 50.

Sir Arthur Eddington stressed the importance of basing cosmological investigations upon a standard of length which would be accepted not only in relativity, but also in quantum theory and in metrology. Since such a standard can only be specified in terms of dimensionless numbers, it would necessarily be a structure with definite quantum numbers or composed of a definite number of atoms, as, for example, 10^9 lattice spaces of calcite. Finally, he stressed that theoretical cosmology is a normal and natural extension of well-known physical principles and deplored the mystery with which this subject is sometimes cloaked.

Prof. W. H. McCrea referred to recent nebular counts by Shapley which appear to indicate that the distribution is not isotropic, and he showed by a very simple argument that Hubble's velocity-distance relation would still remain true in any assigned direction. The Astronomer Royal also referred to the lack of homogeneity revealed in Shapley's observations, and appealed to mathematicians to develop a more general theory capable of dealing with this more complex situation. Dr. McVittie in replying to these comments stated that in his very latest paper Shapley admitted that his former conclusion is rendered uncertain by an error of calibration, but he believes that when the correct calibration is completed, there will still remain some lack of isotropy in the nebular distribution.

Prof. W. Wilson stated that in spite of its simplicity, Milne's cosmological theory suffers from the defect that it does not incorporate detailed gravitational phenomena such as planetary motions. On the other hand, he felt that in the domain of general relativity the early simple theory of de Sitter may be an adequate expression of the facts. Prof. Temple said in reply that the de Sitter universe is in fact the ultimate state of all the continually expanding models proposed by general relativity.

[1] *Rev. Mod. Phys.*, **5**, 62.

A Congress of Aeronautical Geography

THAT there are relations between geography and aviation was officially acknowledged, so to speak, for the first time in the week of November 28–December 3, when the First Congress of Aeronautical Geography (Premier Congrès de Géographie Aérienne) was held in Paris under the auspices of the French Ministers for Air and National Education. It had been organized by the Union Syndicale des Industries Aéronautiques (not by a geographical body), the vice-president of which, General Duval, acted as chairman, and eminent representatives of French science and aviation served as chairmen of various sessions. Twenty-two papers were read, dealing with the different aspects of aviation so far as they may be of interest to the geographer.

The programme commenced with two meteorological papers, read by Messrs. G. Dedebant and A. Viaut, of the French National Meteorological Office, and an excellent discourse on the international regulation of civil aviation, given by Dr. A. Roper, secretary-general of the International Commission for Aerial Navigation. M. R. Bureau, of the Meteorological Office, discussed the stratosphere, and the well-known pre-War pilot and aeronautical inventor, M. R. Esnault-Pelterie, spoke on interplanetary space. A number of papers dealt with the geographical and economic conditions and the statistical results of commercial aviation in general (M. J. Vivent, sub-director of civil aeronautics in the Air Ministry) and of different long-distance air-lines (Messrs. R. Perret, vice-president of the Association des Géographes Français: line France–Madagascar of Régie Air-Afrique; Prof. J. Martin: lines France–South America and France–Indochina of Cie. Air-France; Prof. J. Weulersse: line London–Capetown of Imperial Airways Ltd.; F. Ruellan, director of studies: line Amsterdam-Batavia

of Koninklijke Luchtvaart Mij.; Prof. E. Dennery: line New York–San Francisco of United Air Lines, Inc.). The services which aviation is able to render to geography and allied sciences were discussed by the following: M. A. Carlier, manager of the Société Générale de Photo-Topography (on aerial photography); Prof. P. George (on the role of aviation in the exploration of the polar regions); Father Poidebard (on the exploration of ancient civilizations by aeroplane); Prof. A. Demangeon (on the investigation of agricultural systems from the air); M. F. Blondel, chief mining engineer (how to employ the aeroplane for geological investigations and for prospecting); Prof. E. de Martonne (on the contribution of aviation to morphological studies); M. G. Huisman, director-general of Fine Arts (on the aid of aviation in studying and conserving the architectonic treasures of France). There was also an interesting *causerie* by the well-known airman, M. P. Codos, on trans-continental and trans-oceanic flights. A number of other papers were of a more technical character.

It is to be regretted that the attendance at the Congress was not large; the date of the meeting had been chosen with regard to the sixteenth International Aeronautical Exhibition held at the Grand Palais des Champs-Elysées, but it is obviously not very convenient for a scientific congress. Though the meeting had been intended to be an international one, the speakers were, without a single exception, French, and nearly the same is true of the hearers, among whom there were only half a dozen foreigners. It is to be hoped that the next Congress of Aeronautical Geography, which will be held in 1940, again in Paris, may have larger and more international support.

CARL HANNS POLLOG.

The Testing of Electrical Switchgear

THE Department of Scientific and Industrial Research stated last year that at the request of a number of manufacturers of switchgear, it was considering the establishment of a short-circuit testing station at the National Physical Laboratory which would be capable of testing switchgear specified to be able to break a circuit having a current I flowing in it with a possible maximum voltage V across the gap of the circuit breaker, when the product of V and I is 250 million volt-amperes, certain limitations being made as to the value of V and I. The cost of such a laboratory would be very high, as it would have to be built at an appreciable distance from other laboratories and it would have to generate its own power. Only a limited number of full-scale tests could be made per annum and so it would need a large Government grant.

The Department, therefore, issued a questionnaire to interested firms and bodies, inviting their views on various aspects of the proposal and on certain tentative proposals by means of which the National Physical Laboratory might be able to issue certificates that the gear has successfully passed certain specified tests. The replies disclosed a considerable measure of agreement. It was desirable to provide testing facilities which would be available for those manufacturers who did not possess testing stations, and that it should also be possible for such manufacturers to obtain certificates issued by an independent body in respect of such tests. At the same time, those companies which have already erected short-circuit testing stations for their own use indicated some doubt as to whether additional testing capacity in Great Britain was justified as there were already in existence greater testing facilities than are available in any other country in which switchgear is produced. They pointed out that they had spare capacity available. They offered to assist the Department in exploring the proposal further by supplying information from their own experience. As the result of most friendly discussions with the Department, it appeared possible to collaborate with the owners of existing short-circuit testing stations and so provide facilities in those stations for testing for any British manufacturer. Negotiations to this end began in 1937.

Agreement has been recently reached on a scheme which it is hoped will be adequate to meet requirements. This scheme permits the existing testing stations to continue to issue their own certificates, and in addition provides facilities for the issue of N.P.L. certificates when required in respect of circuit-breakers coming within the agreed range which attain a standard of performance defined in the appropriate British Standards specification. The negotiations were made much easier by the fact that the owners of existing stations had already taken preliminary steps to co-ordinate their work and had provisionally decided to form an 'Association of Short-Circuit Testing Authorities' which would act as a testing or certifying body. This Association is now being incorporated. The main features of the new scheme are as follows. Owners of testing stations will provide facilities to any British manufacturer, without distinction, and will undertake that the full-time use of one test bay will be made available collectively, by the existing testing plants, for tests for those manufacturers who do not themselves own testing stations. Tests will be normally carried out to the requirements of a definite British Standards specification. While the Association of Short-Circuit Testing Authorities will issue its own certificates of rating and records of performance, it will be possible to obtain N.P.L. certificates. Application for N.P.L. certificates under the arrangements should be addressed to the Director, National Physical Laboratory, who will decide at which station any individual test can be made. Strict confidence will be observed in connexion with the design of circuit-breakers submitted for test.

The stations at present included in the scheme are those of: The English Electric Co., Ltd., the General Electric Co., Ltd., the Switching Testing Co., Ltd., Trafford Park, which is jointly owned by the British Thomson-Houston Co., Ltd., Messrs. Ferguson Pailin, Ltd., and the Metropolitan-Vickers Electrical Co., Ltd.; The British Short-Circuit Testing Station, Ltd., Hebburn-on-Tyne, owned by Messrs. A. Reyrolle and Co., Ltd. As soon as the National Physical Laboratory is ready to receive orders for tests, leaflets giving full details of the arrangements for tests, including particulars of charges, will be available.

Protective Films on Metals

TWO papers presented at the Autumn Meeting of the Institute of Metals by Drs. L. E. Price and G. J. Thomas dealing respectively with "The Tarnishing of Silver and Silver Alloys and its Prevention" and "Oxidation Resistance in Copper Alloys" may well represent the commencement of a new era in the investigation of alloy systems resistant to oxidation and scaling. It has been suggested by Wagner that for a film to provide marked resistance to further oxidation high electrical resistance, such as is offered by films of the pure oxides of aluminium, beryllium or silicon is required. This hypothesis is abundantly confirmed by the present authors' work.

When, however, alloys of silver or copper are heated in air under normal conditions, such resistant films cannot be produced owing to the fact that both the constituents of the alloy oxidize simultaneously, yielding a coat, the electrical resistance of which is not high. Optimum results can only be expected when films of a suitable pure oxide are formed. The problem, therefore, with which the authors were faced was the production of films of this type, and their solution of the difficulty calls for the highest praise. By an appropriate pre-treatment protective films of alumina have been formed on alloys of silver or copper containing 1 per cent of aluminium, and remarkable resistance to oxidation and tarnishing both at room and at elevated temperatures has been obtained.

Two methods have been developed for the formation of such films of alumina or beryllia; first by a selective oxidation of the aluminium or beryllium in the alloy by heating in hydrogen containing a partial pressure of water vapour of 0·1 mm., or by the cathodic deposition of films of these oxides. Some idea of the magnitude of this research even in its present stage will be gathered from the fact that 70,000 specimens of silver and its alloys have been exposed for periods up to one year in fifteen different locations.

This work is as yet in its experimental stage, and until data are available regarding the mechanical properties of the films, and particularly their resistance to abrasion, it is not easy to visualize the practical possibilities of the process. It is probably true to say, however, that no more serious disservice to such practical application could be done than by inducing the authors prematurely to abandon their present purely scientific treatment of the subject and to devote their attention to the empirical and routine examination of alloys of possible industrial significance.

F. C. T.

Research on Concrete

THE steadily increasing use of concrete in the construction of buildings and roads has given added impulse to the efforts being made to ascertain how its quality may be improved and how it can be used to the best advantage. One of the most important of the factors which influence the properties of this material is the grading of the aggregate and new and valuable light has been thrown on this by the investigations made at the Building Research Station and at the Road Research Laboratory, the results of which have now been published*.

That the strength of concrete depends directly upon the ratio of water to cement and that other factors are of importance mainly in so far as they affect this ratio is now well established. It follows that the grading of the aggregate determines the strength of the concrete inasmuch as it influences the water content required to bring it to the desired degree of workability. The now widely known method of consolidating concrete by vibration may be used to obtain increased strength because it is possible thereby to consolidate a drier mix, thus reducing the necessary water: cement ratio. The term 'workability' has generally been held to convey an impression of the ease or otherwise with which a mix can be placed, but no precise definition has previously been attempted. It is shown here that the only part of the applied work which is usefully employed in the preparation of the mix is that used in overcoming the internal friction of the concrete and the friction between concrete and mould or reinforcement. Of this useful work, the only portion depending on concrete alone is due to the internal friction and, from this consideration, workability is defined as the property which determines the amount of internal work required to compact the concrete.

For the measurement of this property, the slump test is shown to be defective in two respects, and the compacting factor test, finally chosen as suitable, is based on the above definition and measures the amount of compaction produced by the application of a standard quantity of work. In order to determine the effect of compactness a series of tests was carried out in which the specimens received different amounts of tamping and therefore contained different proportions of air-voids. The loss of strength due to a degree of under-compaction, as measured by the proportion of air-voids, was found to be 30 per cent when the voids were 5 per cent and as much as 90 per cent with 25 per cent of air-voids. It was shown also that, provided the specimens were fully compacted and had the same water-cement ratio, quite large variations of aggregate grading and shape of particles had no appreciable effect on strength. The grading is of importance only in so far as it affects workability and the water-cement ratio necessary to obtain the required workability, and its suitability should be judged in relation to the cement content and the degree of workability required.

The paper fully describes the tests made, and gives photographs in illustration of them, while the quantitative results are adequately set out in tables and curves. From the various data supplied it should be possible for the engineer to obtain the best combination of workability and strength for any particular purpose.

* Department of Scientific and Industrial Research and Ministry of Transport, Road Research, Technical Paper No. 5. "The Grading of Aggregates and Workability of Concrete." (London: H.M. Stationery Office.) 1s. 3d.

Science News a Century Ago

Royal Astronomical Society

AT the anniversary meeting of the Royal Astronomical Society held on February 8, 1839, the council congratulated the Society on the flourishing conditions of its finances, and on the activity and zeal which were displayed in all branches of astronomical science, marked more especially by the recent discovery of the parallax of the fixed stars, by two of the fellows of the Society in different hemispheres. Obituaries of deceased members were read and mention made of the services they had rendered to science; special reference was made to the late Dr. Bowditch of Boston. The gold medal for the year was awarded to the Hon. John Wrottesley for his catalogue of the right ascension of 1318 stars—a work which had been of great assistance in the formation of the new general catalogue then in course of reduction.

Sir John Wrottesley, afterwards Baron Wrottesley, was born in 1798 and died in 1867. A barrister by profession, he served as president of the Royal Astronomical Society in 1841–43 and as president of the Royal Society in 1854–57.

Nitrogen in Plants

"SOME experiments made by Boussingault," said the *Athenæum* of February 9, 1839, "show that trefoil, cultivated in a soil previously calcined to a red heat, admits a certain quantity of nitrogen into its organisation, which probably proceeds from the atmosphere. On repeating the experiment with peas, a similar result was obtained; and besides this, the peas, with no other nourishment than that which had been derived from water and air, have flowered and yielded perfect seeds, and the nitrogen was more than double in quantity to that originally contained in the peas. On comparing these experiments with those made on oats, etc., it appears that only certain plants are apt to derive nitrogen from the air, but the manner in which this elementary body fixes itself in vegetables is not known."

University Events

LONDON.—Dr. John McMichael has been appointed to the University readership in medicine tenable at the British Postgraduate Medical School. He will take up his duties early in March. Since 1936 he has been Johnston and Lawrence research fellow of the Royal Society of Edinburgh and extra honorary assistant physician at the Royal Infirmary, Edinburgh.

Dr. W. T. J. Morgan has been appointed as from January 1, 1939, to the University readership in biochemistry tenable at the Lister Institute of Preventive Medicine. Since 1929 he has been biochemist and first assistant in the Serum Department of the Institute at Elstree.

The title of professor emeritus of mycology in the University has been conferred on Prof. E. S. Salmon, formerly University professor of mycology at the South-Eastern Agricultural College.

Mr. C. C. L. Gregory, lecturer in astronomy at University College, has been appointed director of the University Observatory.

Societies and Academies

Paris

Academy of Sciences (*C.R.*, **208**, 57–131, Jan. 9, 1939).

A. LACROIX: Silent stages in the formation of a new crater of the caldera type at the summit of the Piton de la Fournaise (Reunion Isle).

E. ESCLANGON: Definition of force in the special theory of relativity.

B. SEGRE: A fundamental theorem of geometry on algebraic surfaces.

S. EILENBERG: Co-homologies and continuous transformations.

R. SALEM: Mean convergence of Fourier series.

L. KANTOROVITCH and A. PINSKER: General forms of partially additive functions in certain semi-ordered spaces.

N. OBRECHKOFF: Zeros of some *fonctions entières*.

C.-T. CHUANG: Holomorph functions in the *cercle unité*.

E. LEFEBVRE: Functions of a complex variable defined by a linear relation between the variable and logarithm of the function, the coefficients being some polynomials related to the function.

O. YADOFF: A method of measuring the speed of the 'front' of a gaseous jet.

C. SĂLCEANU: The velocity of sound in binary mixtures of liquids, by a resonance method.

T. V. IONESCU: Mode of action of ionized gas oscillators in the magnetic field.

MME. Z. SOUBAREW-CHATELAIN: Application of the conductimetric method to the simultaneous determination of molybdic acid and of ammonia in the ammono-molybdates.

G. CHAUDRON and A. MICHEL: Thermo-magnetic characteristics of cubic iron sesqui-oxide.

L. DUNOYER: Emission from the ends of luminescent tubes: numerical results.

G. DÉCHÊNE: A new type of photo-electric cell. The contact resistance of a semi-conducting piece of treated 'Cellophane' applied to a layer 2–3 mm. thick of yellow or red mercuric oxide can be used for qualitative work in the visible and ultra-violet.

MLLE. M. PEREY: Element 87, a derivative of actinium. There would appear to be two isotopes of atomic number 87, one of short life (21 min.) announced here, and another of long life found by M. Hulubei.

B. PONTECORVO and A. LAZARD: Nuclear isomerism produced by a continuous spectrum of X-rays.

G. OCCHIALINI: Measurement of the effect of latitude on cosmic ray showers. Measurements at sea between Bahia and Trieste suggest that the showers are due to radiation of the same quality in both equatorial and temperate regions.

R. DELAPLACE and C. BÉCHARD: Determination of freezing point and boiling point, at reduced pressure, of mixtures of ethylglycol and water.

P. BASTIEN: Researches on the evolution in air, in water and in a vacuum, of brittleness due to acid pickle in extra-soft annealed steel.

P. CARRÉ and L. PEIGNÉ: Some anti-oxygen effects from the point of view of the practical rule of the 'electronic strain'.

L. PALFRAY and S. SABETAY: Catalytic dehydrogenation, by means of Raney or ordinary nickel.

J.-H. HOFFET: Genesis of iron beds on the right bank of the Red River (Tonkin). There is a large reserve of iron capable of exploitation.

C. DAUZÈRE : Geographical distribution of lightning strokes in the Département du Gers.

MLLE. M. CELAN : New preliminary researches on the synapses of red algæ.

R. GAUTHERET : Possibility of realizing indefinite culture of tissues of carrot tubercules. Such tissue has been maintained for more than a year, and is very resistant to changes of conditions.

M. AUBERTOT : Presence of a dorsal contractile vessel in the genus *Acerentomon*.

P. CHABANAUD : Geonemy of unsymmetrical teleosteans.

P. CHAUCHARD : Chronaximetric analysis of the block of conduction in nerves ; realization of a paralysing heterochronism.

A. POLACK : Correcting glasses for those operated on for cataract.

P. LÉPINE and P. SÉDALLIAN : Presence of poliomyelitic virus in the intestinal contents of a living infant in an infected family ; isolation of the virus.

Amsterdam

Royal Netherlands Academy (*Proc.*, **41**, No. 9, 1938).

L. RUTTEN : Geological investigations in mid-Dalmatia and Herzegovina.

J. G. VAN DER CORPUT : Hyperconvex aggregates in the plane.

T. L. DE BRUIN and J. N. LIER : Absorption spectrum of thorium.

B. J. D. MEEUSE : Some observations on special structures in the cell walls of plants.

J. VAN SOEST : Tilted late breccias on the south-eastern Biokovo slopes (Dalmatia).

F. DE WITT PUYT : The Klobuk (a mountain) at Ljubuški, a tectonic klippe.

D. G. MONTAGNE : Some Rudistæ and Nerineidæ from mid-Dalmatia.

F. KEIJZER : Middle Eocene Foraminifera from the flysch in the neighbourhood of Omiš, Dalmatia.

A. TEN DAM : Foraminifera from the Oligocene and Miocene of the Eastern Netherlands.

M. J. L. DOLS and B. C. P. JANSEN : Studies on phosphorus metabolism in normal and rachitic rats with a radioactive phosphorus isotope (2). The total phosphorus and lipin phosphorus content and the formation of lipin phosphorus.

E. FREY : Studies on the hypothalamic optical nerve of the Amphibia (1). *Rana mugiens*, *Rana esculenta*, *Bombinator pachypus* and *Pipa pipa*. (2) *Proteus anguineus* and the phylogenetic significance of the hypothalamic optical nerve.

A. MOCHTAR and W. K. MERTENS : Single cell culture of *Leptospira*.

Brussels

Royal Academy (*Bull. Classe Sci.*, No. 11, 1938).

C. J. DE LA VALLÉE POUSSIN : Irregular points. The determination of masses by potentials (2).

P. BURNIAT : Note on certain varieties of Segre.

L. LINSMAN : Certain topological evolutions.

L. DERWIDUÉ : Fundamental surfaces of the second kind of the birational transformations of four-dimensional space.

J. THOREAU and J. VERHULST : Atacumite from Katanga. Crystallographic, optical and X-ray investigations on this mineral.

J. PASTEELS : Sensitizers and an organizer in the activation of the egg of *Barnea candida*.

J. BRANDÈS : Effects of the local application of ultra-violet rays on the blastulæ and gastrulæ in the Discoglossa.

Copenhagen

Royal Danish Academy of Sciences and Letters, October 21.

NIELS BOHR : Reactions of atomic nuclei. In connexion with the communication of a paper, written in collaboration with G. Placzek and R. Peierls, a general survey is given of the use of simple mechanical ideas and thermodynamic analogies to explain several characteristic features of nuclear reactions.

November 4.

FRITZ BUCHTAL and J. LINDHARD : Physiology of the striated muscle fibre. On the basis of the experimental results from work on isolated cross-striated muscle-fibres, a new contraction hypothesis is put forward. The anisotropic segments of the myofibrils consisting of myosin-chains are more or less stretched in an electrostatic field in the resting fibre. On excitation, this electric field decreases, the myosin micellæ become coiled up, whereby the fibre contracts.

November 18.

J. N. BRØNSTED : Foundation and formulation of the thermodynamic laws. On the basis of points of view previously stated concerning the impossibility of heat-work transformation in ordinary thermodynamics, the fundamental conceptions and principles in thermodynamics are developed in a form which to some extent deviates from the traditional treatment of the subject.

December 2.

OTTO NEUGEBAUER : An edition of an Egyptian astronomical papyrus (Pap. Carlsberg 9) prepared in collaboration with A. Volten. The papyrus contains a calculation of new moons and for the first time gives some insight into a mathematical astronomy among the Egyptians. [See also NATURE of January 21, p. 115.]

December 16.

C. M. STEENBERG : An examination of the Skrydstrup woman's hair and the material of her dress.

Vienna

Academy of Sciences, December 7.

H. HABERLANDT : Radiobarytes from Teplitz and Carlsbad. It is found that the radioactive material is concentrated on the surface of the barytes crystals, and in particular along cracks. The fluorescence spectrum of the barytes from Teplitz indicates that the radioactive material is uranium, while the Carlsbad mineral contains no uranium and probably owes its activity to radium.

F. WERNER : Report of eight scientific expeditions to Greece.

S. BLATTMANN : Stratigraphy and tectonics of the Radstädter Tauern.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Monday, February 6

UNIVERSITY COLLEGE, LONDON, at 5.—Prof. J. H. Burn: "The Action of Drugs in Muscular Fatigue and as Circulatory Restoratives" (succeeding lecture on February 8).*

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. H. S. W. Massey: "Quantum Statics" (succeeding lectures on February 20, March 6, 17 and 20).*

BIRKBECK COLLEGE PHYSICAL SOCIETY, at 6.—Prof. G. I. Finch, F.R.S.: "Structure of Work Surfaces"*.

Wednesday, February 8

UNIVERSITY COLLEGE, LONDON, at 7.30.—Dr. E. C. Willatts: "The Use of Land in Planning the London Region"*.

ROYAL SOCIETY OF ARTS, at 8.15.—R. Kronfeld: "Gliding and Soaring".

Thursday, February 9

BEDFORD COLLEGE FOR WOMEN (in collaboration with the SOCIETY FOR THE PROTECTION OF SCIENCE AND LEARNING), at 5.15.—Prof. Gilbert Murray: "Why should Science and Learning be Protected?"*

CHEMICAL AND PHYSIOLOGICAL SOCIETIES, at 5.30.—Discussion on "The Use of Isotopes in Biology", to be opened by Prof. G. von Hevesy.

Friday, February 10

ROYAL INSTITUTION, at 9.—Prof. Max Born: "Cause, Purpose and Economy in Natural Laws".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

SCIENTIFIC OFFICER in the Air Ministry Scientific Research Pool—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (Ref. No. 301 *O*. February 17).

ASSISTANT LECTURER IN ZOOLOGY in University College, Exeter—The Registrar (February 20).

PROFESSOR OF VETERINARY SCIENCE and PROFESSOR OF AERONAUTICS in the University of Sydney—The Universities Bureau of the British Empire, 88a Gower Street, London, W.C.1.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 782, Vol. 237: The First Spark Spectrum of Platinum. By A. G. Shenstone. Pp. 453–470. 2*s*. 6*d*. No. 783, Vol. 237: Rotational Analysis of the First Negative Band Spectrum of Oxygen. By Thomas E. Nevin. Pp. 471–507. 6*s*. Series B: Biological Sciences. No. 561, Vol. 229: A Study of some Factors governing the Choice of Hosts and Distribution of Progeny by the Chalcid *Oencyrtus kuvanæ* Howard. By Dr. D. C. Lloyd. Pp. 275–322. 6*s*. No. 562, Vol. 229: Studies of the Post-Glacial History of British Vegetation. 1: Origin and Stratigraphy of Fenland Deposits near Woodwalton, Hunts.; 2: Origin and Stratigraphy of Deposits in Southern Fenland. By Dr. H. Godwin and M. H. Clifford. Pp. 323–406. 10*s*. (London: Cambridge University Press.) [61

National Physical Laboratory. Collected Researches. Vol. 24: Standards. Pp. iii+450+19 plates. (London: H.M. Stationery Office.) 22*s*. 6*d*. net. [61

Twelfth Annual Report, October 1, 1937, to September 30, 1938, of ULAWS (the University of London Animal Welfare Society.) Pp. 32+xii. (London: ULAWS.) [61

Second International Conference for the Protection of the Fauna and Flora of Africa, London, May 1938. Final Act. Pp. 149. (London: H.M. Stationery Office.) 2*s*. 6*d*. net. [91

Proceedings of the Royal Society of Edinburgh, Session 1938–1939. Vol. 59, Part 1, No. 2: The Establishment of the Trichromatic Theory of Colour Vision. By Prof. W. Peddie. Pp. 15–21. 6*d*. Vol. 59, Part 1, No. 3: Importance of Dialysis in the Study of Colloids. 5: Colloidal Gold; 6: Colloidal Vanadium Pentoxide. By Dr. B. H. Desai, P. M. Barve and Y. S. Paranjpe. Pp. 22–37. 1*s*. 6*d*. Vol. 59, Part 1, No. 4: Some Eocene Ostracoda from North-West India. By Mary H. Latham. Pp. 38–48. 1*s*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [91

Other Countries

Memoirs of the Faculty of Science, Taihoku Imperial University. Vol. 21, No. 2 (Mathematics No. 30): On a Pair of Surfaces Mutually Related (7). By Sôzi Matumura. Pp. 25–32. Vol. 21, No. 3 (Mathematics No. 31): Beiträge zur Geometrie der Kreise und Kugeln (24). Von Sôzi Matumura. Pp. 33–68. Vol. 21, No. 4 (Mathematics No. 32): Beiträge zur Geometrie der Kreise und Kugeln (25). Von Sôzi Matumura. Pp. 69–88. Vol. 21, No. 5 (Mathematics No. 33): Beiträge zur Geometrie der Kreise und Kugeln (26). Von Sôzi Matumura. Pp. 89–126. Vol. 21, No. 6 (Mathematics No. 34): Beiträge zur Geometrie der Kreise und Kugeln (27). Von Sôzi Matumura. Pp. 127–176. (Taihoku: Taihoku Imperial University.) [91

U.S. Department of Agriculture. Circular No. 495: The Sweet-potato Leaf Beetle. By Loyd W. Brannon. Pp. 10. 5 cents. Circular No. 508: The Comparative Attractiveness of Various Small Grains to the Chinch Bug. By Curtis Benton and W. P. Flint. Pp. 8. 5 cents. (Washington, D.C.: Government Printing Office.) [91

Smithsonian Miscellaneous Collections. Vol. 97, No. 10: Fourth Contribution to Nomenclature of Cambrian Fossils. By Charles Elmer Resser. (Publication 3487.) Pp. 44. (Washington, D.C.: Smithsonian Institution.) [91

U.S. Department of the Interior: Office of Education. Bulletin 1938, No. 12: Development of State Programs for the Certification of Teachers. By Benjamin W. Frazier. Pp. vii+166. (Washington, D.C.: Government Printing Office.) 20 cents. [91

Report on the Administration of the Meteorological Department of the Government of India in 1937–38. Pp. iii+43. (Delhi: Manager of Publications.) 12 annas; 1*s*. [91

Gold Coast. Report on the Forest Department for the Year 1938. Pp. ii+18. (Accra: Government Printing Department; London: Crown Agents for the Colonies.) 1*s*. [91

Report of the Committee on the Measurement of Geologic Time, 1937–1938. Presented at the Annual Meeting of the Division of Geology and Geography, National Research Council, April 30, 1938. Pp. iii+123. (Washington, D.C.: National Research Council.) [91

Pasteur Institute of Southern India, Coonoor. The Annual Report of the Director for the Year ending 31st December 1937, together with the Thirty-first Annual Report of the Central Committee of the Association for the Year ending 31st March 1938. Pp. 89. (Coonoor: Pasteur Institute.) [91

Conseil International des Unions scientifiques: Union Internationale de Géodésie et de Géophysique: Association Internationale d'Hydrologie scientifique. Bulletin N. 23: Sixième Assemblée Générale à Edimbourg du 14 au 26 Septembre 1936. 2: Partie des Travaux de l'Association. Comptes-rendus et Mémoires des Commissions des Neiges et des Glaciers. Pp. xiii+804. (Paris: Association Internationale d'Hydrologie scientifique.) [191

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 171: A New Transformation in the Iron-Nickel-Aluminium System. By Syûiti Kiuti. Pp. 553–582. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 5 sen. [231

Herbertia. Vol. 5, Dedicated to Ernst H. Kreiage. Edited by Hamilton P. Traub. Pp. 218. (Orlanda, Fla.: American Amaryllis Society.) [231

Report of the Danish Biological Station to the Ministry of Agriculture and Fisheries. 42, 1937. By Dr. H. Blegvad. Pp. 64. (Copenhagen: C. A. Reitzels Forlag.) [231

Fisheries Experiment Station of the Government-General of Tyosen. Annual Report of Hydrographic Observations. No. 8: For the Year 1933. Pp. v+194. (Husan: Fisheries Experiment Station.) [231

University of Sydney Publications in Geography. No. 2: The Erosion-Pastoral Problem of the Western Division of New South Wales. By Macdonald Holmes. Pp. 52. (Sydney: University of Sydney.) 2*s*. [231

Bulletin of the Madras Government Museum. New Series, General Section, Vol. 3, Part 3: Catalogue of Venetian Coins in the Madras Government Museum. By T. G. Aravamuthan. Pp. ii+60+1 plate. (Madras: Government Press.) 1.8 rupees. [231

Memoirs of the Geological Survey of India. Vol. 72, Part 2: The Geology of parts of the Minbu and Thayetmyo Districts, Burma. By E. L. G. Glegg. Pp. viii+137–318+xxx+plates 12–17. (Calcutta: Central Book Depot.) 6.2 rupees; 9*s*. 6*d*. [231

Memoirs of the India Meteorological Department. Vol. 26, Part 8: Measurements of the Radiation from the Sun and the Sky at Poona in 1935. By P. K. Raman. Pp. 151–164+plate 10. (Delhi: Manager of Publications.) 1.4 rupees; 2*s*. [231

Contributions from the Biological Laboratory of the Science Society of China. Zoological Series, Vol. 12, No. 8: Study of some Forest Insects of Nanking and its Vicinity, Part 1. By C. P. Miao. Pp. 131–182. Zoological Series, Vol. 12, No. 9: Birds of Nanking and its Vicinity, Part 1. By L. T. Chong. Pp. 183–374. (Shanghai: Science Society of China.) [231

League of Nations. Survey of National Nutrition Policies, 1937–38. (Official No.: C.478.M.321.1938.II.A.) Pp. 120. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 2*s*. 6*d*. [231

Annals of the New York Academy of Sciences. Vol. 38: Molluscan Faunas of the Domengine and Arroyo Hondo Formations of the California Eocene. By Harold Ernest Vokes. Pp. iii+236+22 plates. (New York: New York Academy of Sciences.) [231